APRIL 15, 1961

AUTOMOTIVEINDUSTRIES

ENGINEERING

MANAGEMENT

PRODUCTION

DESIGN

A CHILTON PUBLICATION

IHC ENGINES

... FOURS MADE ON V-8 MACHINE LINES ... Page 58



Above:—The 100-ton BARC, built by Transval Electronics Corp., is the World's largest amphibious vehicle. Speed is 10 knots in water, 20 mph on land.

ALSO IN THIS ISSUE

POTENTIAL POWERPLANTS FOR CARS
BUICK AND OLDSMOBILE ENGINES
NEW PLANT OF TWIN COACH COMPANY



INTERNAL GRINDING...

Are Two Wheels Better Than One?

by George H. Lockwood

Manager, Research & Development
The Heald Machine Company

Until very recently, internal grinding of a straight or taper bore has always been done with a single grinding wheel. Although this method has worked very well and will continue to be widely used, it is subject to inherent limitations under some circumstances.

In the first place, using the same wheel for both rough and finish grinding requires a compromise in grit selection. A wheel coarse enough for maximum efficiency of stock removal in the roughing portion of the cycle may not give a sufficiently smooth surface for the finish grinding operation. So grinding speed must be weighed against surface finish, and a suitable compromise selected.

Secondly, in single-wheel grinding the wheel is usually dressed between the rough and finish portions of each grinding cycle. This increases the total cycle time by the time necessary for the dressing operation.

Both of these limitations have been removed by a unique double-wheel grinding arrangement which was first demonstrated publicly by Heald at the 1960 Machine Tool Exposition. This setup uses a single wheelhead with two separate wheels mounted on the same spindle—one for rough grinding and the other for finish grinding (see diagram below). Actual wheel specifications can be determined on the basis of maximum performance—a coarser roughing wheel for faster stock removal and a finer finishing wheel for a lower micro-inch finish. Change from rough grinding to finish grinding is simply a matter of automatically changing the position of the machine table, with no interruption of the cycle. Both wheels are dressed while the work is being loaded, hence dressing adds no time to the cycle. This represents a significant reduction in overall cycle time.

With these resultant advantages-more efficient rough and

finish grinding plus no time out for dressing—a workpiece that would ordinarily require 25 to 30 seconds on a single-wheel machine, can now be ground in less than 10 seconds by the two-wheel method.

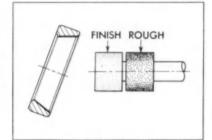
This new method is ideally suited to high production runs where maximum output is essential. But it is not the universal solution to all grinding problems. Wheel costs may run somewhat higher, since both wheels are normally dressed during each cycle and as much is removed from the finishing wheel as from the roughing wheel. An economic study of your particular requirements will show which method—one wheel or two—will yield the maximum return on your machine investment.



Heald Model 190A Centri-Matic internal grinding machine arranged for high speed double-wheel grinding of bearing races.

Your Heald engineer will be glad to tell you more about this interesting development. It PAYS to come to Heald.

Diagram of doublewheel setup for grinding taper I.D.s of bearing outer races. The roughing wheel is mounted nearest to the wheelhead to reduce spindle deflection under heavy feeding pressure.



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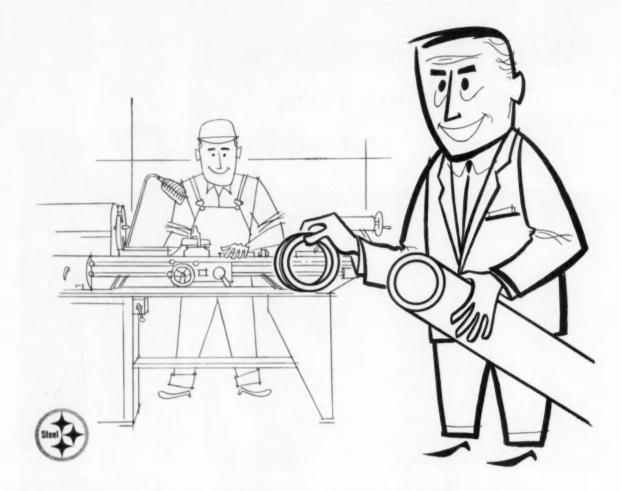
Made by The J. R. Clark Company, Spring Park, Minnesota, the ingenious Rid-Jid "Lifetime" ladder was designed almost entirely of sheet steel for the last word in safety, comfort, and convenience. Its special finish provides all-weather durability; rubber "shoes" give it sure footing even on slippery floors. Like other products in the Rid-Jid line, this ladder has the quality and the muscle that only sheets of steel can give.

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AUTOMOTIVE INDUSTRIES

CHILTON MAGAZINE . PUBLISHED SEMI-MONTHLY

APRIL 15, 1961

Passenger Cars * Trucks * Buses * Aircraft * Tractors • Engines • Bodies • Trailers • Road Machinery • Farm Machinery • Parts and Components • Accessories • Production and Processing Equipment • Design . Production . Engineering . Management

VOL. 124 No. 8

Features

Potential Powerplants for Passenger Cars

The Diesel engine, gas turbine, free-piston engine, battery power, fuel cell, Stirling engine, and NSU (Curtiss-Wright) engine are discussed and evaluated. Page 55

Four-Cylinder Engine Components Machined on V-8 Engine Lines

International Harvester Co. is machining components for its new four-cylinder engine over the same transfer line installed for the V-8. Page 58

Design Features of the Buick Special and Olds F-85 Engines

> Both of these aluminum engines have the same basic structure, but many of the components are not identical. Page 60

Retooling the Cylinder Block Line at Deere's Waterloo Works

> Production of cylinder blocks for the new John Deere tractor engines is handled on a line of modern machine tools. Page 64

Bristol T-188 Probes "Thermal Thicket" with All-Steel Structure

> Designed to measure flying qualities and aerodynamic heating at hypersonic speeds, Bristol Aircraft's Type-188 makes extensive use of stainless steel. Page 66

How Buick Uses Emission Spectrometers

Buick Motor Division has a special X-Ray emission spectrometer which is equipped with a vacuum chamber for the specimen. Page 68

Machining Large Differential Carriers at International Harvester Co.

> Three large single-purpose machines have been installed at IHC for operations on the differential carrier used on through-drive tandem rear axles. Page 70

New Twin Coach Plant

The Waverly, N. Y., plant of the Twin Coach Co. was put into operation within 65 days of receipt of orders for Mighty-Mite vehicles and Army ordnance trailers. Page 72

Celanese Introduces New Acetal Plastic

A new thermoplastic, named Celcon, is offered as a replacement for metals in automotive decorative and functional parts.

19 New Product Items and Other Features Such as:

Machinery News; Manufacturers' News; Industry Statistics: and European Round-

. . . continued on next page

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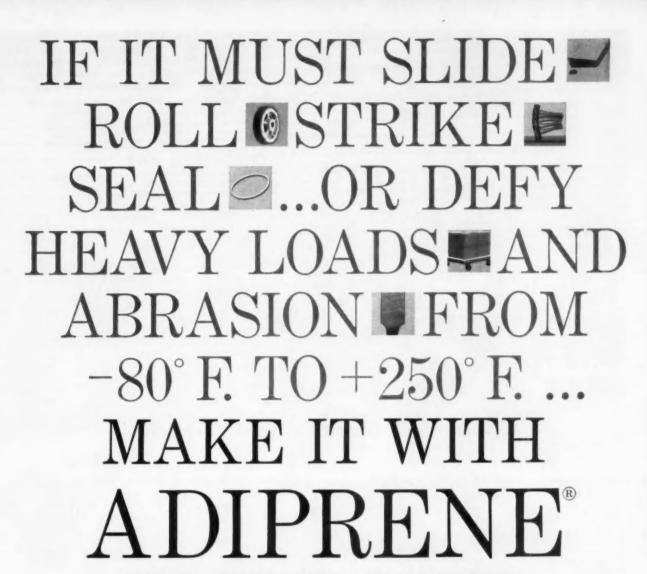
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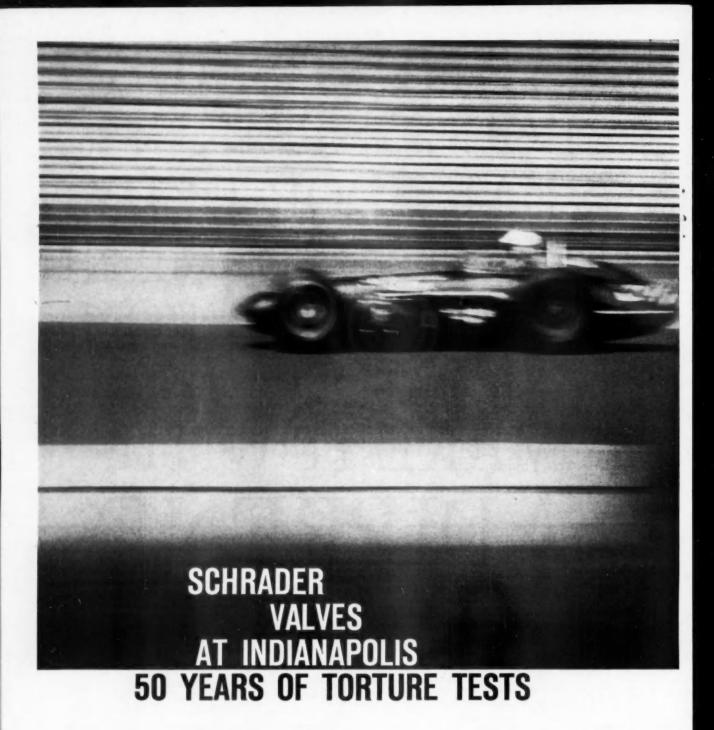
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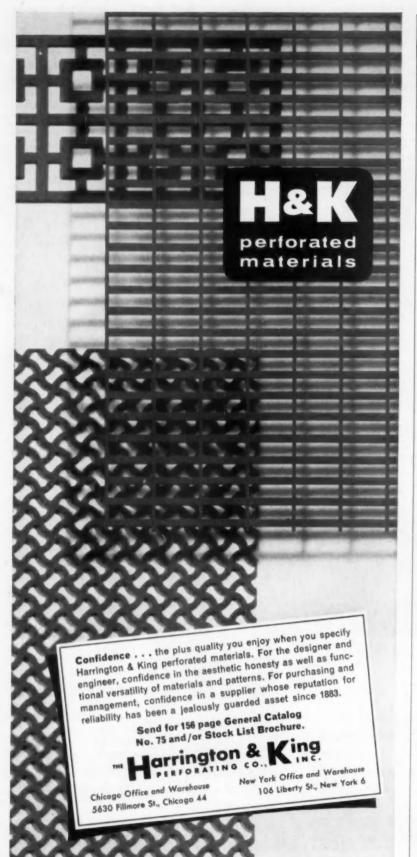
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OF COMING SHOWS AND MEETINGS

| 43rd | Annive | rsary | Nation | nal Tr | uck, | |
|------|----------|-------|--------|--------|------|-------|
| 7 | railer & | Equ | pment | Show, | Los | |
| A | Ingeles | | | | Apr. | 13-15 |

| Instrument | Soc | ciety | of | America. | |
|------------|-----|-------|-------|-----------|-------|
| Symposis | um | on | Inst | trumental | |
| Methods | of | Anal | ysis, | Houston | |
| | | | | Apr. | 17-19 |

| American | Welding | Society, | 42nd | |
|----------|------------|----------|-------|-------|
| Annual | Convent | ion and | Weld- | |
| ing Ext | nosition I | New York | Ann | 17 21 |

| W | estinghouse | 25th | Machine | Tool | | |
|------------------|-------------|------|---------|------|----|--|
| Forum Pitteburgh | | | Ann | 10 | 20 | |

American Society of Mechanical Engineers, Metals Engineering Conference, Pittsburgh Apr. 23-26

1961 Powder Metallurgy Show & Metal Powder Industries Federation Meeting, Cleveland. Apr. 24-26

American Zinc Institute, 43rd Annual Meeting, Chicago May 1-2

Lead Industries Association, 33rd Annual Meeting, Chicago ... May 2-3

American Society of Mechanical Engineers, Lubrication Symposium, Miami BeachMay 8-9

Material Handling Institute, Eastern States Show, Philadelphia May 9-11

American Institute of Industrial Engineers, National Conference and Convention, Detroit ... May 11-13

Association of American Battery Manufactures, Spring Convention, New OrleansMay 15-17

Design Engineering Show and Conference, DetroitMay 22-25

Instrument Society of America, Instrument - Automation Conference & Exhibit, Pittsburgh. June 5-8

Society of Automotive Engineers, Summer Meeting, St. Louis. June 5-9

American Society of Mechanical Engineers, Annual Summer Meeting, Los Angeles....June 11-15

Seminars in Industrial Engineering, Cornell University, Ithaca, N. Y. June 13-16

American Society for Testing Materials, Annual Meeting, Atlantic City, N. J. June 25-30

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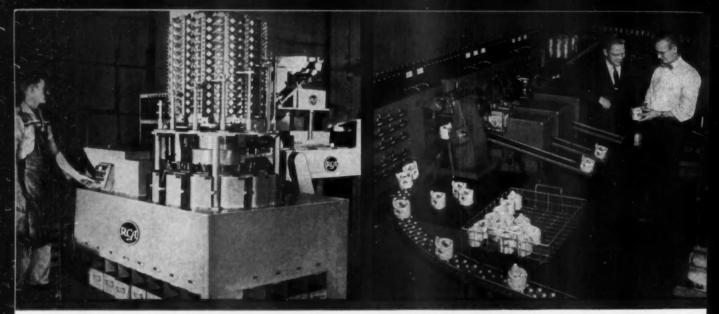
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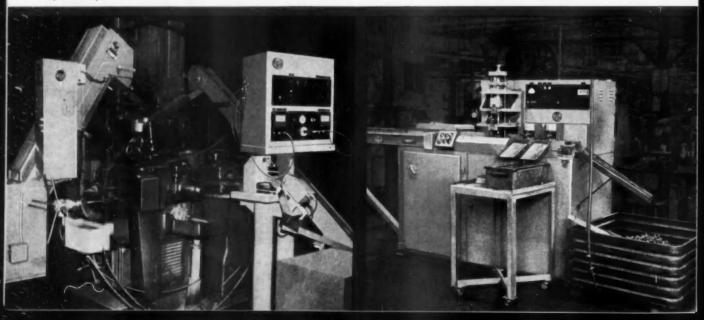


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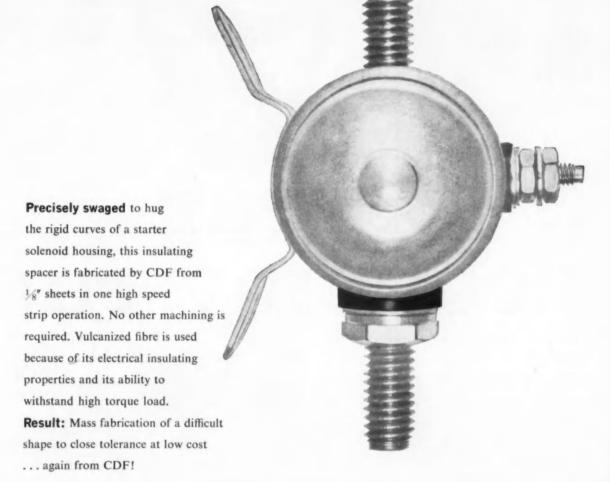
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1949 135 hp

1953 175 hp



Readers' opinions or requests for additional information on material appearing in the editorial pages of AUTOMOTIVE INDUSTRIES are invited for this column. No unsigned letters will be considered, but names will be withheld on request. Address Letters to the Editor, AUTOMOTIVE INDUSTRIES, 56th & Chestnut Sts., Philadelphia 39, Pa.

GROUND EFFECT MACHINE

In your issue of March 1, you show a picture of Bell's Air Cushion Vehicle and state that it scoots over the ground or water on a cushion of air, presumably with the greatest of ease. I might wish to qualify this statement somewhat from a technical viewpoint, but it is most certainly true that given the proper circumstances, the GEM will, in fact, operate somewhat as advertised. You go on to say, however, that the craft is licensed to operate on New York roads, inferentially, at least, just as an automobile would. Since I do little driving on New York roads, I really cannot protest too much, but I would most certainly do so if any such proposal were made in Arizona.

Presuming, as one must, that the GEM when underway is equivalent to any airborne vehicle of low performance, there are a number of problems immediately arising which make over-the-road operation hazardous to both the GEM or any other vehicle trying to use the same highway. As one extreme hazard, consider the effect of wind. In any cross wind, the GEM must travel to windward at a velocity equal to the wind force vector normal to the road, in order to maintain a straight ground track. Assuming the most simple case of a constant 20 mph cross wind-the vehicle must be moving relative to the air in which it travels at a cross-road speed of something over 29 ft per sec. If the wind suddenly stops, as in a cut, behind a wind break, or passing a truck on a down-wind side, the vehicle will crab across the road into the wind

at that velocity. Thus, it would be displaced some 18 ft in the normal reaction time of a good driver. In gusty winds, the directional control problem would, of course, be much worse. In a similar vein, if the wind were directly on the nose or on the stern of the vehicle, true ground speed would vary depending on the velocity of the wind. True ground speed indicators are possible, but at the moment, the best of such devices operates on a Doppler radar principle and cost more than a dozen Cadillacs.

For various specific purposes one can see useful applications of the GEM, but as a replacement for the auto for normal driving, it leaves much to be desired. I would think that if New York has, in fact, licensed such a vehicle for the general over-the-road use, it is asking for trouble and will undoubtedly get it.

S. B. Spangler Vice Adm., U.S.N., Ret. Director of Research The Garrett Corp. Phoenix, Ariz.

HYDROSTATIC TRANSMISSION

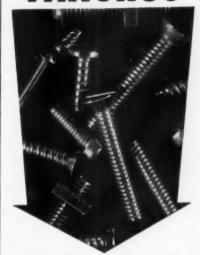
We note with pleasure the editorial appearing in the March 1 issue of "Automotive Industries" on our hydrostatic transmission.

If possible, we would appreciate receiving five copies for distribution purposes. If there is any charge, please advise.

> M. A. Gordinier Advertising Watertown Division New York Air Brake Co. Watertown, N. Y.

• No charge-Ed.

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and die plant in the world



DETROIT . MICHIGAN



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Celanese maintains strict control of Celcon production, from raw materials to finished polymer. Celanese is the world's largest producer of trioxane—basic monomer of Celcon production. Celcon is now available for your evaluation in developmental quantities on a restricted basis.

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- Combines low cost with high strength and rigidity
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- Excellent colorability
- Unusual versatility in molding
- · Broad molding range

Uses as Varied As Industry Itself

Celcon, as a fabrication material and styling medium offers many advantages over metals and other materials for a wide variety of applications, such as timing gears, door handles, pipe and plumbing, sporting goods, automotive parts, electrical appliance parts, machinery housings and components, pump parts and impellers. But these are only an indication of where this versatile new engineering material can be used to both product and cost advantage.

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For complete details, please write, outlining your application, to:

Celanese Polymer Company, Dept. P-172-D, 744 Broad Street, Newark 2, N. J.

Celanese Polymer Company is a Division of Celanese Corporation of America

"The superior quality is evident at first glance...

... that's why we recently decided to stock LUSTERIZED cold finished steel bars ?



SAYS J. T. ERWIN, VICE-PRESIDENT OF ELLIS-ERWIN SUPPLY CO., INC., TAMPA, FLA., who stands in the group at the right with J. E. Ellis, Jr., Sales Manager, W. Gray Ellis, Purchasing Agent and E. C. Cox, Office Manager.



BLISS & LAUGHLIN LUSTERIZED bars are immediately distinguishable from ordinary cold finished steel bars in the racks at Ellis-Erwin,

Mr. Erwin reports. Mr. W. Gray Ellis and Mr. Erwin are shown checking the close tolerance and superior finish of a Lusterized bar.



THE SAVINGS that can be realized during production with Lusterized Finish bars are figured by Mr. Erwin and Mr. Ellis.

When a long-established steel service center decides to concentrate on selling a particular line of cold finished steel bars, the bars obviously must be superior.

That is precisely why Ellis-Erwin Supply Co., Inc., Tampa, Fla., selected Bliss & Laughlin Lusterized

Finish steel bars.
Mr. J. T. Erwin, Vice-President, writes: "We intend to expand our cold finished sales considerably

in 1961. There is a marvelous opportunity in our area with your products. The exclusive quality-pluses and the fast service you render will help us achieve our goal of furnishing the best products to our customers . . ."

This is another example of why more progressive steel service centers stock and recommend Bliss & Laughlin Lusterized Finish bars than any other cold drawn bars.

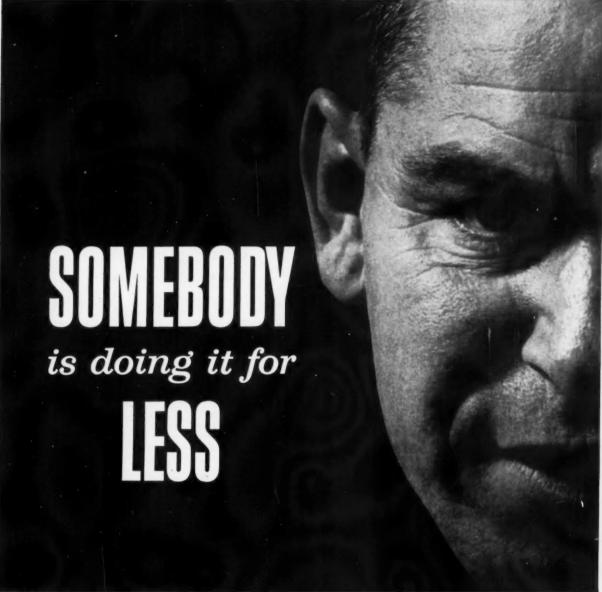
Leading Independent Producer of Cold Finished Steel Bars

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location (angle) and
amount meters for each
correction plane. Readings hold until corrections are made. Offers
complete plane separation—needs no special
foundation—correction
planes can be inside or
outside work supports.

New HS line handles miniature, high-speed parts—impellers, armatures, gyros, self-driven assemblies.

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One year? Two years? Take a fresh look. If you still rely on operator skill or judgment, accuracy suffers, time is lost, reject rates or field failures are high.

With Gisholt balancers, guesswork is eliminated. You can locate, measure, correct and inspect in one handling.

Only Gisholt offers all the advantages you need to do it for less.



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Conversion Coatings

FOR FINISHING ZINC OR CADMIUM

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The wide range of Iridite coatings available gives you a choice of corrosion protection-from economical, mild protection of parts for shipment, storage or display, to extremely high protection under exposure to marine and highly humid atmospheres, gasoline or other hydrocarbons.

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Your choice of colors ranging from clear through yellow iridescent to olive drab. Bright Iridite finishes can also be dyed to provide other color effects.

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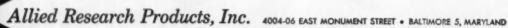
Iridite, in combination with other Allied Research processes, can provide a wide variety of finishes. As an example, Iridite 8-P applied to zinc or cadmium, followed by an application of Irilac, gives a highly attractive simulated brass finish.

IRIDITE—a specialized line of chromate conversion coatings for nonferrous metals. Easily applied at room temperatures with short immersion times, manually or with automatic equipment. Forms a thin film which becomes an integral part of the metal. Cannot chip, flake or peel. Special equipment, exhaust systems or highly trained personnel not required.

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The bottom drive machine <u>above</u> has practically everything—enclosed design, Clearing's dual speed clutch,

moving bolsters, hydraulic overload units, die cushions and locks—everything to make it a major contribution to Japan's bustling economy.

Want to make your production bustle? Clearing can supply the answer with the kind of thinking you need—with press equipment best suited for your purposes—mechanical or hydraulic, large or small. Let's talk.



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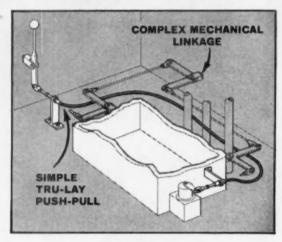
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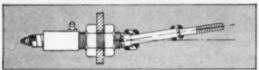


THESE FEATURES HELP SOLVE DESIGN PROBLEMS

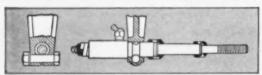
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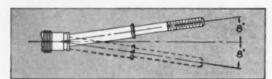


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Standard assemblies have end fittings with a swivel movement of \pm 8° to compensate for misalignment and rise or fall of lever arms. Swivel joints, and the sliding ends, are sealed against dirt and moisture.

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 Write for your PUSH-PULL Data File. It contains a complete set of engineering bulletins which describe in detail the operation of PUSH-PULL CONTROLS, their applications, features and advantages.

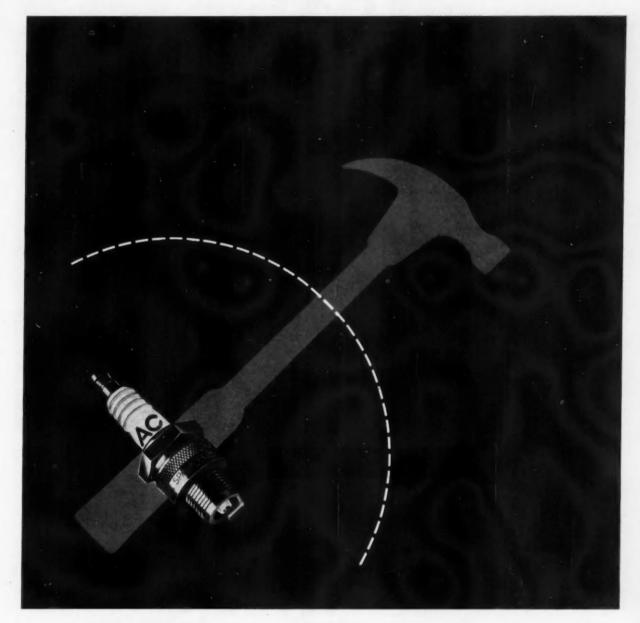
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Grommets of Silastic Withstand 350F; Effectively Seal Coolants

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A factor in the performance of their engines is a set of 24 cylinder-head grommets made of Silastic®, the Dow Corning silicone rubber. The grommets proved so effective in Cummins' new engines, they are now specified as standard components on other models throughout the Cummins line. These resilient silicone rubber rings are positioned over the entrances to coolant passages in the top of the block. They prevent leakage of coolant and antifreeze into the engine and the costly damage that could result. The grommets snap into the cylinder head gasket where they remain flexible and sure-sealing, despite attack by cooling fluids and engine temperatures in the 300 to 350 F range.



Oil seals, diaphragms, and many other automotive parts are fabricated of long-lasting Silastic, too. Original physical properties are essentially retained in temperatures from -130 to 500 F; resist oxidation, weathering, moisture and compression set. Silastic stays rubbery under the most adverse operating conditions — provides a combination of properties that permit components of this "talented" material to meet rigid performance requirements.

Your rubber fabricator can design parts to build longer life and customer-pleasing performance into your automotive products. For full information, write Dept. 0916.



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Amchem service in automotive phosphating processes goes far beyond the sale of chemicals.

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In the past Amchem service has achieved signifi-

cant advances in automotive prepaint finishing, among them—Deoxidine, the first corrosion-proofing treatment for use in mass production of steel automobile bodies; the first spray process for rust-proofing steel; and Granodine, the spray phosphating process that has become the accepted standard in industry.

Amchem has spent a lifetime (all 46 years of its corporate existence) providing phosphating services to the automotive field. If your requirements embrace more than phosphating chemicals alone, look to Amchem's Metal Protection Laboratories where, automotively speaking, we speak your language!



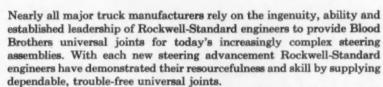
AMCHEM PRODUCTS, INC.

(formerly American Chemical Paint Co.)

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For example, the development of power steering and tilt cab trucks introduced the need for more intricate steering shaft assemblies. Rockwell-Standard engineers met the challenge with universal joints capable of transmitting power around corners without any sacrifice in operating performance or steering safety.

PARTICULARLY IMPORTANT IS THE ROCKWELL-STANDARD DEVELOPMENT OF:

- An anti-backlash universal joint for steering columns that provides greater precision in steering control.
- A specially designed machine that tests every Blood Brothers steering joint at 4000-inch pounds of torque. This pre-shipment precaution insures dependable steering that cannot fail even under extreme torque pressure.

Whatever the steering assembly, whatever problems it presents, Rockwell-Standard engineers can design and develop universal joints that are reliable, efficient and economical.



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NEW Bullard Mult-Au-Matic Type "M"

Contrary to the general upward trend in the cost of new plant production equipment, The Bullard Company is offering the *new* Type "M" Mult-Au-Matic at a price which is *lower than competitive* methods.

Designed and built according to exacting Bullard standards, the *new* Type "M" Mult-Au-Matic incorporates many new features of rigidity, accuracy and productivity which have made this machine famous the world over.

For complete information on the *new* Bullard Type "M" Mult-Au-Matic, call your nearest Bullard Sales Office or Distributor or write to

The Bullard Company, Bridgeport 9, Conn.



Wear-Guard construction trap up to 40% more dirt than any other filters tested. Another example of Fram's leadership in the research, development and manufacture of filters.

No wonder in 1961, the majority of America's automobile manufacturers choose Fram to supply original equipment filters. Why not let Fram Engineers put their skill and know-how to work on your filtration problem?

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FRAM CORPORATION, PROVIDENCE 16, R. I.

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No other metal has the strength, beauty and versatile qualities that serve you so well today and promise so much for tomorrow.

There is nothing like stainless steel for THE AUTOMOTIVE INDUSTRY



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Manufacturers of high quality Stainless and Carbon Steels



McLOUTH STAINLESS STEEL



Trucks pay out on the road, not in the shop. So it's asking for trouble when a truck engine is too big for its clutch.

To help keep 'em rolling, Borg & Beck has developed a new line of 2-plate clutches with up to 40% greater load capacity . . . yet without any increase in nominal size.

Rated at 500 ft.-lbs. torque capacity, this new Borg & Beck Type 13E2 has 12%" O.D. x $7\frac{1}{4}$ " I.D. facings . . . non-cushion rigid or flexible center drive plate . . . space for 16 heat treated coil springs of total load to suit type of service . . . "strap drive" for positive, trouble-free plate separation.

And like all Borg & Beck clutches, Type 13E2 is built to Borg & Beck's pace-setting standards for quality, performance and value. Consult our engineers for details.



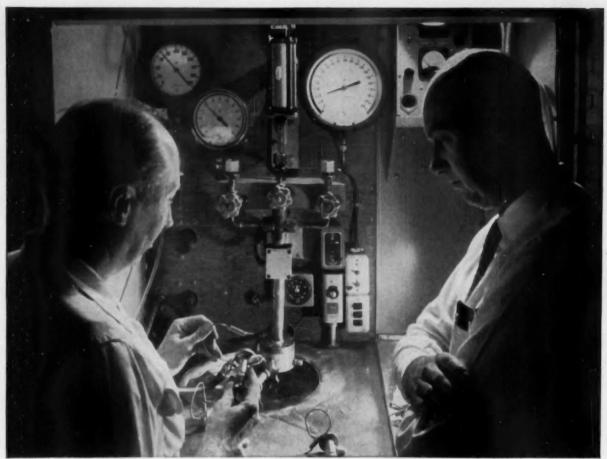


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Export Sales: Borg-Warner International, 36 S. Wabash, Chicago 3

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ROAD-TESTING Air Conditioning Valves in 32° Water Shows up Trouble Before It Happens

The test begins with valves at room temperature. Their pig-tail thermal tubes have the valve wide open, because room temperatures are hot for a cooling coil.

The valve is lowered into the 32° water. Immediately it starts to close. The big outlet pressure gauge starts down...slowly. The operator watches for any rapid movements. If needle falls smoothly, comes to rest at a proper point, and holds steady, valve action is OK.

In our Milwaukee plant, each automotive air conditioning valve device receives at least 6 different checks in testing booths like above before shipment. Our Quality Control system gives us reason to be proud...and our customers, happy.

If you have a problem in automotive air conditioning controls, our engineers can help you. A phone call will put their experience at your command. Checking the test: Fred A. Frey, Manager of Quality Control, Heating and Air Conditioning Division.

These automotive air conditioner and automobile manufacturers rely on Controls Company of America's AP controls: CHRYSLER FORD AMERICAN MOTORS STUDEBAKER-PACKARD FORD, MERCURY DIV. ARA
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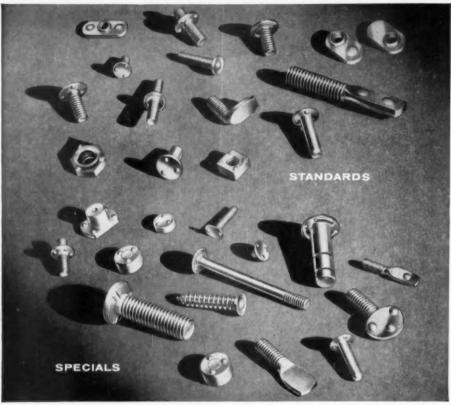
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NAT'S quick facts about Fasteners...





Welding Fasteners...

the little things that make a big difference

Welding Fasteners put threads into the most unlikely places, and make light of the weightiest assembly problems.

Where hands and wrenches can't get in, for instance, or where material dimensions or contours make it next to impossible to use regular fastening methods, Weld Nuts or Weld Screws neatly side-step the difficulties . . . and make assembly simple, fast and foolproof.

We could go on and tell you more about Welding Fastener advantages . . . in improving product design and quality, increasing production efficiency, and cutting costs . . . and we'll be very glad to, if you like.

Right now, though, we'd just like to say that when you need certain standard Weld Nuts or Weld Screws, and you want to be sure they're designed right and made right . . . that's where we come in. We know Welding Fasteners, and we stock many of the most commonly used.*

We might just mention, too, that we happen to be particularly adept at developing Special Fasteners for welding. They can often be designed to do a better job and save money for you. Ask us about your applications.

*Standard types and sizes are illustrated and listed in National's booklet on Welding Fasteners. Write for your copy.





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NEWS

Vol. 124, No. 8

April 15, 1961

Army Costs to Increase

Mobility Needs for Next Decade Discussed

Cost of keeping the Army's air and ground mobility in an advanced stage of preparedness will increase from \$4.2 billion in 1962 to \$6.5 billion in 1964, 1965 and 1966 and then will drop slightly during the next three years.

These estimates of Army needs for the next 10 years are related

to recognition of the Army's role as a constant readiness force, John F. Greco, of the Marketing General Office, Hughes Aircraft Co., told defense industry leaders in Washington, D. C.

"In limited war," Mr. Greco said, "Army forces, exclusive of those elements committed to Continental Air Defense—provide the backbone for the fighting ground-naval-air team as was the case in Korea. It is apparent that the Army's role is to provide a constant readiness force available for any type of land combat throughout the full spectrum of war—from simple police actions to full scale nuclear war.

Readiness Force

"Army materiel requirements for the next 10 years are directly related to a recognition of the Army's role as a constant readiness force. This recognition has brought with it an increase in the Army's portion of the defense budget-however as an aside I might mention that Army procurement would have had to increase because of the wearing out and obsolescence of the present \$14 billion inventory. Attrition rates alone account for approximately 10 per cent-or \$1.4 billion of the Army's total materiel per year. Additionally, modern equipment has not been procured in recent years in the amounts desired.

"In projecting Army materiel requirements for the next decade, and I would like to emphasize that these are my own personal estimates, I have taken into consideration the fact that the Army is in a transition period, and that operational and organizational concepts are still not firm. The Army's Modern Mobile Army Con-

OLDSMOBILE'S EXPERIMENTAL F-85 CUTLASS



A sister to Buick's Skylark, the Cutlass will be announced publicly in about a month. Bucket seats are standard. The plastic roof, luxury interior and exterior trim will be features of the latest General Motors sports coupe.

cept, publicly released last spring, is already undergoing revision. So, in this projection of requirements, though I have taken cognizance of the various organizational and concept studies that have been released, I have not tied myself down to any one of them.

"I expect a rather sharp increase in total funds during the next three fiscal years, then a leveling off for two years followed by a drop for several years, and finally a slight increase beginning in 1970. This is based on the assumption that by 1967 the Army will have substantially completed its modernization program. This is a bit slower than the Army would like, but the realities of the budget have to be accepted. In the early '70s, another period of major re-equipment should begin.

\$21 Billion for 10 Years

"The total funding through 1971—and this is for limited war which excludes continental U. S. air defense— is approximately \$20.8 billion. Of this total, air mobility would take 15 per cent, or \$3.16 billion; missiles and rock-

ets is 35 per cent, or \$7.29 billion, and control 17 per cent, or \$3.41 billion.

"Non-mission oriented research is four per cent of the total, or \$1.02 billion.

"Ground mobility includes jeeps, passenger cars, the GOER cross country transport vehicles, and all tactical wheeled vehicles. In the conventional firepower category I have included the small arms-the M14 rifle, the M60 machine gun, recoilless rifles, chemical and conventional munitions. the 105 and 155 mm howitzers, the 175 mm gun and the M60 tank. Logistic support includes such things as the amphibious LARC. tank transports, construction and engineering equipment, fork lifts, combat recovery and repair vehicles. All of the programs that I have enumerated are highly important if the Army is to be ready for its mission of fighting anvbody, anywhere, at any time.

"Concerning tactical mobility, the Army's ultimate goal is 100 per cent vehicular mobility, ground and air, for all the combat and combat support units."

Excise Tax Assailed

Removal of the Federal excise tax on automobiles would stimulate car sales and the entire national economy, a top Ford Motor Co. official declared.

Lee A. Iacocca, vice president and general manager of Ford Div., said "jobs depend on incentives instead of deterrents," and added "the removal of the excise tax, which the customer pays when he buys a new car, would give a powerful impetus to automobile sales, would have an almost immediate effect on employment and would serve to stimulate the whole national economy."

Stating that taxes are highly discriminatory against automobiles and the car-buying public, Mr. Iacocca said that "since they are imposed on the wholesale price of the vehicle, they are largely hidden taxes. But they add substantially to the total price—approximately \$200 on the average car. It's about time this economic anchor was taken off the back of the car-buying public," Mr. Iacocca said.

S-P Stock Proposal

Studebaker-Packard Corp. has asked shareholder approval to increase its stock issue for possible use in "one or more major acquisitions."

Clarence Francis, chairman, and Sherwood H. Egbert, president, revealed S-P was engaged in preliminary talks with several companies. They said the talks had only been "exploratory" and declined to reveal the companies involved.

BUICK'S SKYLARK—LUXURY SPORTS COUPE



Joining the battle for the sports car enthusiast's attention, Buick offers twodoor sports coupe with new 185-hp engine, a more powerful version of the aluminum V-8 presented in the 1961 Buick line. Its unitized body is 188 in. long, mounted on a 112-in. wheelbase. It has luxury trim and bucket seats. The engine has a four-barrel carburetor and 10.25 to 1 compression ratio.

Ferrari Takes Sebring

Phil Hill of Santa Monica, Calif., and Olivier Gendebien of Belgium won the 12-hour Sebring, Fla., sports car endurance race each for the third time—driving a factory-sponsored Italian Ferrari.

The winning car, a blazing red 12-cylinder model with conventional engine in front, sped for a new record of 210 laps for 1090 mi at an average speed of 91306 mph

The victory gave the Ferrari factory of Modena, Italy, eight points toward the 1961 car manufacturers championship, which the Ferrari team won last year. This was the first of six races for the 1961 car makers title.

The Hill-Gendebien Ferrari went into the lead at 6:50 P.M. when the leading Ferrari driven by the Rodriguez brothers of Mexico City, Pedro, 21, and Ricardo, 18, was forced to take a five-minute pit stop for adjustment of the generator and tail lights.

The Rodriguez brothers finished second.

Another Ferrari, driven by Ritchie Ginther of Santa Monica, Calif., and Count Wolfgang von Tripps of Germany, took third place. Still another Ferrari, driven by Hap Sharpe and Ronnie Hissom, both of Midland, Tex., was fourth.

In fifth place was a little Porsche driven by Bob Helbert, Warrington, Pa., and Roger Penske, Gladwyne, Pa.

Porsche received 2 points for

finishing fifth. The second, third and fourth place winners did not receive points since they were of the same make as the winner.

Brabham Enters '500'

Jack Brabham, champion auto racer, will drive a Cooper-Climax in the golden anniversary 500-mile race at the Indianapolis Motor Speedway on May 30.

With the receipt later of three more entries, a full field of 33 cars is assured.

Latest to join the field were Jack Turner, Seattle, Wash., and Jack Rounds, of Bell, Calif.

The other entry came from Ken-Paul, Inc., of Dallas, Tex., with no driver designated.

At least 25 additional entries are expected and keen competition for the 33 starting positions is assured.

Brabham's car will be powered by a four-cylinder non-supercharged engine with a bore of 3.78 in. and a stroke of 3.74 in. for a piston displacement of 167.3 cu in. This is approximately 88 in. smaller than the Meyer-Drake engines used at Indianapolis by the United States racing fraternity.

Bernstein Elected

David Bernstein has been elected president of the National Truck Tank and Trailer Tank Institute for 1961. Other officers are Norman W. Mueller, vice president and W. E. Kennedy, treasurer.

Chrysler Tank Order

A \$57.4 million contract awarded to Chrysler Corp. by the Detroit Army Ordnance District will continue employment for 1000 persons in Detroit at least through November, 1962.

The award is a follow-on order for 660 M-60 main battle tanks to be assembled at the Detroit Tank Arsenal in Warren, Mich.

Other Army contract awards:

International Harvester Co., Fort Wayne, Ind., \$34,108,456 contract for 3224 five-ton trucks.

Bowen - McLaughlin - York, Inc., York, Pa., \$17,658,413 contract for 200 M-88 tank recovery vehicles.

Chevrolet Div. of General Motors received a \$3,023,570 contract for 1420 trucks. They will be assembled at eight plants in various sections of the U. S.

Dykstra Heads Ford

Directors of Ford Motor Co. have named John Dykstra, vice president in charge of manufacturing, as president. He succeeds Robert S. McNamara, who resigned to accept the position of Secretary of Defense.

Mr. Dykstra, who is 63, also was responsible for Ford's quality program. He is widely known in the industry as a specialist on production problems.

James O. Wright, vice presidentcar and truck group, was named a director and Robert J. Hampson, general manager of tractor operations, was appointed a vice president at the meeting of directors in Dearborn, Mich.

NEWS

CONTINUED

New Models Unveiled At International Show

By C. B. Campbell, News Editor, and Charles A. Weinert, Eastern Editor

Record numbers of exhibits, manufacturers, and visitors marked the fifth annual International Automobile Show in New York City's Coliseum.

Continuing to accept the import challenge, American manufacturers displayed new sports models of nearly every compact. In all, more than 70 makes and 400 cars were displayed by manufacturers from all over the world. Even an American electric car was introduced.

Among the new American models shown to the public for the first time were the Oldsmobile Cutlass and Buick Skylark, 185-hp luxury sports coupes. Other new models in this same category were the Falcon Futura, Corvair SS, Comet S-22, and Tempest Le Mans.

King Midget Debuts

Another U. S. car making its debut was the King Midget, a small single-seat, all-purpose vehicle.

New among the foreign cars were the Jaguar XK-E, Daimler SP-250, GSM Delta, and Sabra sports cars; also Renault's Gordini, and Fiat's Bianchini.

Futuristic show models that drew "ohs and ahs" from the visitors were Ford's Gyron, a delta-shaped car with only two running wheels; three Scimitars of aluminum, designed by Brooks Stevens for Olin Mathieson Chemical Co.; and McLouth Steel

Corp.'s XV'61, designed for operation either on a monorail or on the road. Additional attractive designs were displayed in Chrys-

ler's Turboflite, powered by a gas turbine engine; Brooks Stevens' Excalibur sports car; and Chevrolet's Stingray, a super - sports model.

The American electric-car newcomer is the Henney Kilowatt, powered by 12 six-volt batteries. Presently used mostly by electric utility companies, it has a top speed of 30 mph. Average range of operation is on the order of 40 to 60 miles. The Henney employs a Renault body, transmission, axles, and other components, in combination with a General Electric 7.1 hp electric motor and contactor control. It is being produced in Bloomington, Ill., by the Henney Motor Div., National Union Electric Corp.

The Sabra Sportster, made in (Turn to page 45, please)



Ford Gyron Is Two-Wheeled, Delta Shaped



Stingray Has Corvette Engine, Fuel Injection

ACTUALLY 3 SPRINGS IN ONE! As shown in this enlargement, the As shown in the enargement, thricoil spring is composed of 3 integrated coils. The spring's amazing strength and durability are the result of this triple-coil design.

HEAVY-DUTY OIL RING WITH

TRI-COIL OFFSET SPRING

solves tough oil control problems and only Perfect Circle has it!

Exclusive new Perfect Circle tri-coil spring has maximum area of contact with the ring all the way around—provides more uniform pressure than an ordinary hump-type expander. This results in higher cylinder conformability with less friction.

And, the stainless steel spring is offset in a channel next to the ring slots, rather than being directly behind them. Ventilation is greatly increased, and clogging of the ring and spring is reduced to a minimum.

Heat stability and easy installation are two more of the many more outstanding features of the new Perfect Circle OS 89. Get complete information from your Perfect Circle representative today!

PERFECT & CIRCLE

PISTON RINGS · PRECISION CASTINGS POWER SERVICE PRODUCTS · SPEEDOSTAT

Hagerstown, Indiana

Don Mills, Ontario, Canada



Circle 130 on Inquiry Card for more data

RUGGED MIDLAND BRAKE CHAMBER

TOUGH-BUILT FOR TRUCK SERVICE

DIAPHRAGM is oil and ozone resistant.

ALL METAL PARTS are plated to resist corrosion.

IT'S EASY TO SERVICE. Two-piece clamp band permits quick disassembly without removal of unit. Applies a more uniform clamping pressure.

IT'S RUGGED . . . designed to resist shock. Studs are welded to chamber, an integral part of assembly.

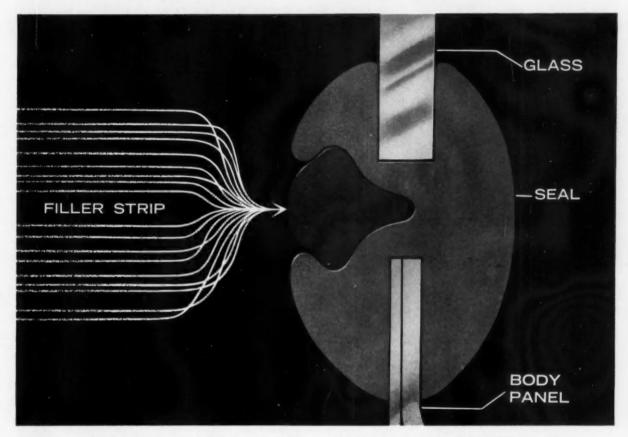
MIDLAND

MIT: MIDLAND-ROSS CORPORATION

ROSS CORPORATION
Owosso, Michigan



STOP LEAKS! SPECIFY INLAND SEAL WITH PRESSURE FILLER!



Basic design insures leakproof seal. Inland Self-Sealing Weather Strip with the separate filler increases pressure that creates a positive leakproof seal-even under extreme conditions.

No matter what your sealing problem, whether glass, metal or plastic, flat or curved, Inland Self-Sealing Weather Strip requires no special mounting surfaces, channels, moldings or binders.

INLAND SELF-SEALING WEATHER STRIP

INLAND MANUFACTURING DIVISION General Motors Corporation . Dayton, Ohio

Installation is fast. Material, time and labor are reduced to a minimum. Make your designing easier and less costly by using an available standard section. If desired we'll custom design to your prints.

Specify Inland Strip and be assured of a troublefree permanently sealed installation.

Phone, wire or write us about your weatherproofing problem. Mail coupon for catalog.

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title

firm name

street address zone state

Circle 132 on Inquiry Card for more data



New torsion-bar truck seats, cushioned by urethane foam, have a lot in common with a strong skier's knees. They absorb impact shock effortlessly.

Just as the skier's knees absorb jolts, jars and vibrations on rugged snowy slopes, so does this new T-bar* seat for drivers traveling on what used to be spine-jarring stretches of roadway.

The spring action principle of a twisting metal bar has been applied to the new seat's suspension mechanism. A quick turn of a handle adjusts the seat for smooth, vibrationless driving for lightweight and heavyweight drivers. Topping and bottoming are prevented by a double-action shock absorber which automatically relieves shock by stiffening spring action.

Naturally, urethane foam was chosen to build even more shock-resistance and comfort into the new seat design. Only urethane foam offers the toughness to stand up to hard use while giving full, firm support. There's no bouncy, jiggling effect of ordinary foam. And urethane foam is easy to fabricate. It can be cut, stitched, tacked, hog ringed or molded to any contour.

For further information on urethane foam cushioning, write to Mobay Chemical Company, Code AI-1, Pittsburgh 5, Pa. Do it today.

Mobay supplies quality chemicals used in the manufacture of polyether and polyester urethane foams.



Viking "TM Bostrom Corporation

WHY THE BIG SWING TO FORD POWER?

Three good reasons

N **ALL FORD FORD INDUSTRIAL** INDUSTRIAL **ENGINES ENGINE FORD** are **PARTS** modern INDUSTRIAL overhead **ENGINE** cost less valve SERVICE design is available

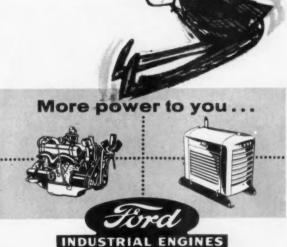
Only Ford offers a complete line of modern, overheadvalve-design engines. Ford Industrial Engines range from 134 to 534 cubic inch displacement, including modern diesels. These are *compact* engines, delivering more horsepower per pound of engine weight than ever before possible! And all Ford gasoline engines are shortstroke for greater fuel economy and longer life.

No matter where he's located, a Ford industrial power user can count on less downtime . . . because there's always a Ford Dealer nearby to give him service when he needs it! Stretching across the country, too, is a complete network of Ford Industrial Products Dealers providing the kind of fast, efficient service that cuts operating costs.

Speaking of cost . . . Ford industrial power users really save on engine parts! Due to Ford's high volume production, parts are priced low. And with 26 Ford Parts depots strategically located across the country . . . delivery of those parts is immediate!

These are just a few of the reasons why *you* should join the swing to Ford power. Call or write to the address below.

YOUR JOB IS WELL-POWERED WHEN IT'S FORD-POWERED!



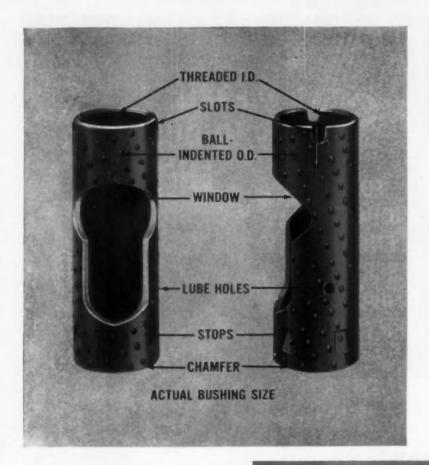
AND POWER UNITS

INDUSTRIAL ENGINE DEPARTMENT, FORD DIVISION, FORD MOTOR CO., P.O. BOX 598, DEARBORN, MICH.

FORD INDUSTRIAL ENGINE DEPT., P.O. BOX 6787, LOS ANGELES 22, CALIF.

West of Rockies write to: FORD INDUSTRIAL ENGINE DEPT., P.O. BOX 1666, RICHMOND, CALIF.

"EXOTIC" BUSHING MAKES NEW STEERING DESIGN COME TRUE



INSIDE-OUT BUSHING HELPS PUT NEW STEERING MECHANISM

INTO PRODUCTION! To perfect a new steering mechanism, an automotive manufacturer required a linkage component. Designers tried making it of machined steel, then plastic . . . both materials failed. But the unusual bushing shown at left, with a number of features F-M engineers helped designers incorporate, solved the problem. It is bronze-on-steel, formed with the ballindented bronze on the O.D. so the bushing can accommodate sliding motion within the mechanism. A large window makes insertion of a ball socket easy during assembly. Design of the bushing also includes: stops near one end to hold a disc . . . a threaded I.D. on the other with slots for a locking pin . . . holes that supply lubricant to the outer surface. For the F-M customer, all these built-in features helped accomplish this result-easy, efficient assembly and success with a new design.

CAN F-M BUSHINGS SOLVE problems on your board or on your assembly line? Or perhaps a sleeve bearing, thrust washer or spacer? F-M, who makes them all, can provide the answer. F-M engineers, with a wealth of knowledge from years of experience, are available to help design the needed component. This complete technical assistance is one reason why these F-M products are widely specified for use in automobiles, form any equipment, construction

farm equipment, construction machinery and many other products.





Additional information about bushings is provided in a Design Guide, published by F-M. Helpful literature is also available on sleeve bearings, thrust washers and spacer tubes. For your copies, write Federal-Mogul Division, Federal-Mogul-Bower Bearings, Inc., 11037 Shoemaker, Detroit 13, Michigan.

FEDERAL-MOGUL

sleeve bearings bushings-spacers thrust washers DIVISION OF FEDERAL-MOGUL-BOWER BEARINGS, INC.

NEWS

FEATURES

(Continued from page 38)

Israel, has a fiberglass-reinforced plastic body, and is powered by a 95-hp Ford engine.

Jaguar's XK-E models, a softtop sports car and a hardtop coupe, represent two of the fastest production models offered to the public. Equipped with a 230.6 cu in. six-cylinder engine, rated 265 hp at 5500 rpm, they are said to be capable of speeds up to 150 mph.

On the economy side, Fiat's Bianchini, with a two-cylinder rear-mounted engine, drew attention from the economy-minded. This model, with a reported top speed of 55 mph, is claimed to get 52 mpg.

Newest Renault at the show was the Gordini, which has an engine rated at 40 hp—25 per cent more than the Dauphine. The increased output was achieved by modification of valves, camshaft, carburetor, and intake and exhaust manifolds.

Another French model on display, the Citroen DS-19, featured air-oil suspension with self-level ride. A five-passenger sedan, it has front-wheel drive and is fitted with power steering.

The newest foreign car, the GSM Delta, has a steel and fiber-glass body and is powered by a Ford 105E overhead valve engine. Its top speed is said to be 105 mph.

A two-seater, the Daimler SP-250 has a new type 140 hp V-8 overhead valve engine. The body is made of reinforced fiberglass. The wheelbase is 92 in. and the length is $160\frac{1}{2}$ in. It is $50\frac{1}{4}$ in. high.

(Turn to page 47, please)



Jaguar XK-E Can Reach 150 MPH



Figt Adds Bianchini to Line



Scimitar Has Aluminum Body

TABLOID =

The proceedings of a Soviet scientific conference to discuss low temperature physics are reported in one of six translations of Russian literature on physics and chemistry released to industry and the public.

A program for testing human performance and for correcting human-initiated malfunctions in the operation of electronic missile systems is outlined in one of three human engineering research reports,

A simple economical method of forecasting the mechanical properties of heat-treated titanium alloy forgings in various upset thicknesses is described in an Army research report. Also available is a research report on corrosion in nickel- and cobalt-base alloys.

Improved techniques for machining high-strength steels, and a literature survey on the machining of high-strength and heat-resistant metals are presented in two memorandums available to industry and the public.

Two new selective bibliographies listing government research reports, translations, and other technical documents on semiconducting materials have been published by the Office of Technical Services, Business and Defense Services Administration.

Manufacturers' shipments of passenger tires in 1960 amounted to 105,799,261 units, the highest recorded shipments in the history of the tire industry. This is 8.6 per cent over the previous high, 97,-399,444 tires shipped in 1959.

Increased emphasis on ceramics research is listed as one of the major recommendations by Defense Dept. researchers in a summary report of proposed new defense research projects compiled by the Defense Research and Engineering Office.

Test data for sheet metal materials used in the construction of high speed aircraft and missiles are presented in one of three reports of government-sponsored metals research released to industry and the public. Two other reports discuss tensile and creep data obtained under rapid heating conditions for various alloys; and bearing creep of forged aluminum alloys.

A power system team of fuel cells and electric motors offers far greater potential than any conventional power plant in meeting future performance requirements for tanks, half-tracks, and other military vehicles. This conclusion is the result of an electrical propulsion study of ordnance land vehicles conducted by the Army.

Combustion of carbon monoxideoxygen mixtures in quartz vessels is discussed in an article translated from a Russian physical chemistry journal. It is one of five translations of Soviet physics and chemistry literature released to science and industry through the Office of Technical Services, Business and Defense Services Administration, U. S. Dept. of Commerce.

The findings of a continuing search for new semiconducting materials capable of high-temperature service as electronic components are described in two Air Force reports available to science and industry.

. . .

Two metallurgical research reports discuss atom-structural factors in the strain-aging behavior of 12 refractory metals, and development of methods and instruments for mechanical evaluation of refractory materials at ultra high temperatures.

Two low-cost, restrained weldmetal hot-cracking tests that give a quantitative measure of weld metal cracking are described in an Air Force metallurgical report.



Philip N. Buckminster has been appointed assistant general manager of the Dodge Car and Truck Div. in charge of truck activities,

AMA Aids Smog Tests

Four automotive engineers, all specialists in the field of vehicle emission control and measurement, have been loaned to California by the automobile industry to assist in the establishment of testing procedures for exhaust control devices, the Automobile Manufacturers Association reported.

The action follows a request from Donald A. Jensen, executive officer of the California Motor Vehicle Pollution Control Board, for technical help to bolster the staff of his new group, established last year by the California Legislature.

The Vehicle Combustion Products Committee coordinates cooperative automobile industry efforts to help alleviate California's unusual form of community air pollution, photochemical smog.

FEATURES CONTINUED

(Continued from page 45)

In the display of futuristic cars, models years in advance of anything on the road today attracted throngs of visitors of all ages.

Chevrolet's Stingray, an experimental Corvette with jet-stream appearance, has a 92 in. wheelbase and is 175 in. long. It is only 31½ in. high at the cowl. Power is supplied by a fuel injection V-8 enigine of 283 cu in. displacement. The fiberglass body has aluminum braces bonded into it. The 35-gal fuel tank also is of fiberglass.

Ford Motor Co. stylists, who developed the Gyron, believe its unique shape and two-wheel concept lend themselves to use of a gyroscope for stabilization. It is 209 in. long, 44.85 in. high and 86 in wide. Two small outrigger wheels toward the rear, one on each side, are retractable. Elimination of the steering wheel is made possible through use of a steering dial which has separate rings for automatic speed and steering control. The dial, combined with individual accelerator and brake controls, permits operation from either seat.

McLouth Steel Corp.'s XV'61, which can operate either on highways or monorails, is made of stainless steel. The four-passenger car and a surrounding monorail system were displayed.

A new competition sports car, the aluminum Excalibur, is the work of industrial designer Brooks Stevens and his two sons. Powered by a 450 hp modified Lincoln engine, it has swing axle rear suspension with inboard rear brakes.

Three Scimitars, research cars built for Olin Mathieson Chemical Corp. by Stevens, utilize aluminum as a body material.



GSM Delta, Made in Britain, Makes Debut



McLouth XV'61 Travels on Road or Monorail



Excalibur Has 450 HP Modified Lincoln Engine



By DAVID SCOTT • Special Correspondent

Shell Research in England has developed a simple method of measuring the operating temperatures of rapidly-moving engine parts such as pistons and valves. The engine is stripped after running, and the changes in hardness of the components under test are interpreted in terms of the maximum temperatures reached and the location of hot spots. Small alloy inserts are used in parts where the metal is unsuited for such observation.

A new German-designed fan using tangential flow, suitable for car heaters and engine cooling among other applications, is being produced in Britain by Solarton, a member of the Firth Cleveland Group. The compact unit is claimed to deliver a silent, turbulence-free flow of air that can travel 15 ft before being broken up by convection.

Curved blades of the paddlewheel rotor, spinning inside specially-shaped baffles, create a cylindrical vortex of air between inlet and outlet ducts. The highspeed periphery of the vortex couples with the air stream and pulls it past the slow-running impeller with a greatly increased velocity.

A French engineer has designed a variable - compression engine that can operate on either spark or compression ignition, or as a Diesel with gasoline starting. A small auxiliary piston, placed in the cylinder head and coaxial with the main bore, is positioned by a rack-and-pinion with hydraulic actuation to alter effectively the volume of the combustion chamber.

Parking Mechanism

From Italy comes news of a "sideways" parking mechanism that fits under the rear bumper of a car. It consist of a small extendable wheel driven by an electric motor powered directly from the generator to avoid battery drain. The device may be offered by a leading Italian auto maker.

Bristol Siddeley Engines is marketing a mobile three-megawatt generating set powered by the Proteus gas turbine used in the Britannia turboprop airliner. The emergency power pack is self-contained in two portable housings that can be transported by a truck-trailer combination or on a railroad flatcar. It can be on full load within two minutes of starting, and is fully automated for remote control.

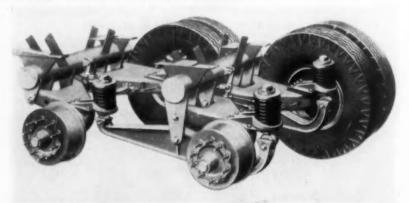
Girling in Germany

British manufacturers are stepping up their foreign operations. Girling will erect a factory at Coblenz, Germany, to produce brakes and other components inside the Common Market tariff barrier. The company already is supplying disk brakes to Mercedes and other European car firms.

United Kingdom car sales at home and abroad have picked up and the industry is back on its feet after the winter slump. Revaluation of the German currency will provide a further boost, as this has hiked the price of German cars.

Communist car makers are trying to push further into western markets. Czechoslovakia may set up a plant in New Zealand to assemble the Skoda from local and imported parts. Russia has established an agency in Denmark, and is probing hard in other European countries where its new rear-engined Zaporozhets is being offered at highly competitive prices.

BRITISH CHASSIS FOR SEMI-TRAILER



Non-reactive suspension bogie, made by Scammell, uses air bellows or stacks of rubber compression disks for springing members. Wheels are independently suspended on individual trailing arms that isolate braking and sideway stress.

INDUSTRY STATISTICAL EDITOR STATISTICS

WEEKLY U.S. MOTOR VEHICLE PRODUCTION

As reported by the Automobile Manufacturers Association

| | Weeks | Ending | Year to Date | | |
|-------------------------------|------------|-----------|--------------|-----------|--|
| Make | April 1 | March 25 | 1961 | 1960 | |
| PASSEN | GER CAR P | RODUCTION | | | |
| Total American Motors | 6,779 | 6,486 | 73,430 | 136,048 | |
| Chrysler | 1.752 | 2.205 | 22.478 | 27,851 | |
| De Soto | 11100 | 21200 | | 12,800 | |
| Dodge | 2.955 | 4.031 | 27.065 | 113.242 | |
| Imperial | -, | 325 | 2.099 | 5.943 | |
| Lancer | 1.235 | 1.341 | 8.523 | 0,040 | |
| Plymouth | 3.641 | 4.714 | 36.316 | 90,699 | |
| Valiant | 2,725 | 2,994 | 23.753 | 72,975 | |
| Total-Chrysler Corp | 12,308 | 15,610 | 120,234 | 323,510 | |
| Comet | 4.447 | 1,285 | 28.732 | 18,776 | |
| Faicon | 9.670 | 4.298 | 95.857 | 129,684 | |
| Ford | 14,309 | 5.270 | 178.938 | 337.013 | |
| | 539 | 3,270 | 7,976 | 7,615 | |
| Lincoln | 2.063 | 226 | 20.885 | 55,804 | |
| Total—Ford Motor Co. | 31.028 | 11.079 | 332.388 | 548,892 | |
| Total Ford Motor Co | , | 11,079 | 332,300 | 040,092 | |
| Buick | 3,769 | 3,860 | 43,813 | 90,343 | |
| Buick Special | 1,750 | 1.667 | 17,405 | | |
| Cadillac | 3.382 | 3,390 | 43,254 | 50.807 | |
| Chevrolet | 21,280 | 22,413 | 294,244 | 507,384 | |
| Corvair | 5,463 | 6.982 | 84.059 | 94.987 | |
| Oldsmobile | 5.273 | 5.752 | 60.667 | 117,403 | |
| Oldsmobile F-85 | 1.380 | 1.457 | 17.820 | | |
| Pontiac | 5.328 | 5,406 | 57.963 | 129,923 | |
| Tempest | 2.547 | 2.462 | 29,734 | | |
| Total-General Motors Corp. | 50,172 | 53,389 | 648.950 | 990,847 | |
| Total-Studebaker-Packard Corp | 1,260 | 1,244 | 13,232 | 34,667 | |
| Checker Motors | 127 | 126 | 1,338 | 1,799 | |
| Total—Passenger Cars | 101,674 | 87.934 | 1,189,581 | 2.035.763 | |
| | AND BUS PE | RODUCTION | | | |
| Chevrolet | 5.618 | 5.942 | 78.097 | 137,945 | |
| G. M. C. | 1.064 | 1.439 | 16.884 | 32,618 | |
| Diamond T | 34 | 43 | 396 | 818 | |
| Divine | 56 | 60 | 704 | 1.140 | |
| Divco | 1.211 | 1.326 | 15,226 | 23.245 | |
| Dodge and Fargo | 7.059 | 6.146 | 81.557 | 105,596 | |
| | 16 | 18 | 214 | 327 | |
| | 3.204 | 2.837 | 34.322 | 37.669 | |
| International Mack | 161 | 196 | 2.451 | 37,009 | |
| Mack Studebaker | 153 | 132 | 1.906 | 2.946 | |
| White. | 365 | 349 | 4.284 | 5.038 | |
| | 2.460 | 2.879 | 26.701 | 33.719 | |
| Other Trucks | 80 | 80 | 960 | 1.336 | |
| Total—Trucks | 21,481 | 21,447 | 263,682 | 386,067 | |
| | 90 | 85 | 785 | 945 | |
| Buses | 80 | 63 | /00 | 343 | |

1961 TRUCK TRAILER SHIPMENTS

Industry Division, Bureau of the Census

| Industry Division, Bureau | of the Cent | sus |
|--|-----------------------------------|---|
| Type of Trailer | January 1961 | Decembe 1960 |
| Vans | 1901 | 1900 |
| Insulated and refrigerated Steel Aluminum Furniture Steel Aluminum All other closed-top. | 372 45 327 64 61 3 | 355 46 309 50 38 12 1,205 |
| Steel Open-top Steel Aluminum | 223 925 176 43 133 | 402 803 173 53 120 |
| Total-Vans | 1,760 | 1,783 |
| Tanks Non- and low-pressure Petroleum and aircraft refuelers Carbon and alloy steel Stainless steel Aluminum | 79 17 94 | 94 14 96 |
| Total—Petroleum | 190 | 204 |
| Chemical, food, and sanitary Dry materials High-pressure (LPG, chemicals, etc.) | 32 25 50 | 36 37 68 |
| Total—Tan's | 297 | 345 |
| Pole, pipe, and logging | | |
| Single axle | 9 9 | 16 12 |
| Total | 18 | 28 |
| Platforms | | |
| Racks, livestock, and stake. Grain bodies. Flats, all types | 32 60 399 | 23 63 421 |
| Total-Platforms | 491 | 507 |
| Low-bed heavy haulers Dump trailers All other trailers | 203 76 222 | 172 53 141 |
| Total-Complete Trailers | 3,067 | 3,029 |
| Dump trailer chassis ¹ Trailer chassis only ¹ | 17 172 | 38 200 |
| Total - Trailers and Chassis | 3,256 | 3,267 |
| Detachable van bodies ¹ | 240 | 132 |
| 1 Sold separately. | | |

NEW PASSENGER CAR REGISTRATIONS BY REGIONS*

| | | | | | Per Cen | Change |
|---|--|---|---|---|---|--|
| Zone 1 2 3 4 5 6 7 | Region New England Middle Atlantic South Atlantic East North Central East South Central West North Central West South Central West South Central | January 1961 19,987 82,297 85,970 86,477 17,781 35,194 36,933 | December 1960 22,093 87,250 64,971 135,518 29,788 57,094 52,465 | January 1960 20, 278 72, 707 65, 882 114, 445 18, 811 32, 589 36, 065 | Jan. over December - 9.53 - 5.68 + 1.54 - 36.19 - 40.31 - 38.38 - 29.60 | Jan. over Jan. 1960 1.44 +13.19 +- 1.13 24.44 5.48 +- 7.99 +- 2.41 |
| 8 | Mountain Pacific | 16,188 52,736 | 21,638 73,461 | 15,852 53,487 | -25.19 -28.21 | + 2.12 - 1.40 |
| | Total—United States | 413,563 | 544,278 | 430,116 | -24.02 | - 3.85 |

* Compiled from official state records. Data property of R. L. Polk & Co. May not be copied, sold or reprinted without Polk permission.

States comprising the various regions are: Zone 1—Conn., Mc., Mass., N. H., R. I., Vt., Minn., Mo., Neb., N. D., S. D. Zone 7—Ark., La., Okla., Tex. Zone 8—Ariz., Colo., Ida., Zone 2—N. J., N. Y., Pa. Zone 3—Del., D. of C., Fla., Ga., Md., N. C., S. C., Va., W. Va.

Mont., Nev., N. M., Utah, Wyo. Zone 9—Alas, Cal., H. I., Ore., Wash.

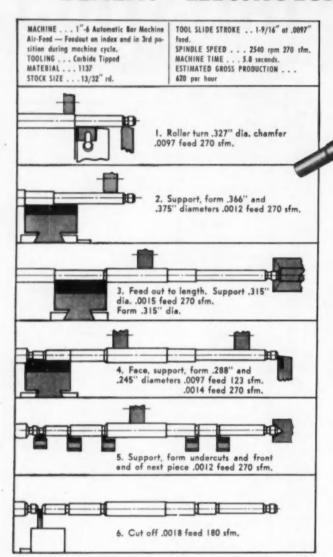
Zone 4—Ill., Ind., Mich., Ohio, Wis. Zone 5—Ala., Ky., Miss., Tenn. Zone 6—Iowa, Kan.

1961 TRUCK FACTORY SALES BY G.V.W.

As reported by the Automobile Manufacturers Association

| January Period February | 6,000 lb. and less 45,034 49,549 | 6,001- 10,000 lb. 13,754 14,423 | 10,001- 14,000 lb. 816 739 | 14,001- 16,000 lb. 1,782 2,304 | 16,001- 19,500 lb. 9,023 9,667 | 19,501- 26,000 lb. 4,628 4,408 | 26,001- 33,000 lb. 1,911 1,712 | 33,000 lb. 2,091 2,019 | Total 79,039 84,821 |
|-------------------------|---|--|-------------------------------------|---|---|---|---|------------------------------|---------------------------|
| Total—Two Months, 1961 | 94,583 | 28,177 | 1.555 | 4.086 | 18,690 | 9.036 | 3,623 | 4,110 | 163,860 |
| Total—Two Months, 1960 | 131,496 | 36,909 | 2.482 | 6.065 | 36,457 | 12.985 | 6,744 | 6,340 | 239,478 |

GREENLEE AIR-FEED AUTOMATICS
BENEFIT "ELECTROLUX" FOUR WAYS

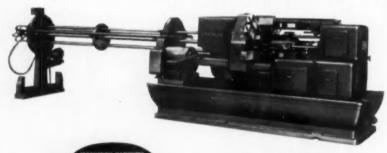




The part is a 6-7/8" long armature shaft used in the "Electrolux" vacuum cleaner. It demonstrates how effectively Greenlee Air-Feed Automatics and carbide tooling can team-up to increase production and reduce costs. The shaft is machined from 13/32" S.A.E. 1137 steel at a gross production rate of 620 pieces per hour. Recommended cutting speed for high speed tooling is 120 sfm. The rate was boosted to 270 sfm with carbide-tipped tooling. Sequence of operations is shown at the left.

Note how the stock is partially fed out on the index and to its full length in the third position. This provides for the most effective tooling arrangement. Greenlee Air-Feed Automatics permit greater job versatility and assure added

profits. See your Greenlee representative or send us a print of your high-cost problem-part.



GREENLEE BROS. & CO.

1975 MASON AVENUE ROCKFORD, ILLINOIS



COMMERCIAL CASTINGS

TRANSPER MACHINES . SPECIAL MACHINES . AUTOMATIC BAR MACHINES . WOODWORKING MACHINES AND TOOLS . DIE CASTING MACHINES . TRIM PRESSES . HYDRAULIC AND HAND TOOLS

MEN

IN THE NEWS



Clark Equipment Co., Industrial Truck Div.—C. W. Bent has been appointed product sales manager.



Heli Coil Corp.— William Bastian will head the new Marketing Div.



Eaton Mfg. Co., Automotive Gear Div.— Robert C. Jacobs has been promoted to general manager.



Gisholt Machine Co.

—Robert H. Presnall
has been named general sales manager.



Walker Mfg. Co.— Rex L. Curry has been appointed manager of original equipment sales department.





International Harvester Co. — J. Stewart Cruickshank has been promoted to manager of the Milwaukee Works and V. A. Guebard, Jr., has been named general superintendent of the same plant.

Garrett Corp., AiResearch Mfg. Div.—James T. Shore has been appointed program manager for industrial gas turbines.

Chrysler Corp.—Frank O. Anderson, II, has been named manager of the American Foundry plant.

Lincoln Electric Co.—A. F. Boucher has been named general sales manager.

General Dynamics Corp., San Diego Div.—Joseph H. Famme has been named assistant division manageroperations.

Divco-Wayne Corp., Divco Truck Div.—Donald Cox has been named sales manager.

Chicago Pneumatic Tool Co., Allen Mfg. Div.—G. A. May has been promoted to executive vice president and general manager.

White Motor Co., Montpelier Div.

—Roy H. Sjoberg has been named general sales manager.

Beech Aircraft Corp.—George R. Selig has been promoted to executive project administrator of all military projects and Roy H. McGregor has been appointed manager of contract administration.

Bliss & Laughlin, Inc., Detroit Automotive Div.—Eugene G. Sheasby has been promoted to vice president.

Fruehauf Trailer Co.—W. S. Potter has been appointed staff assistant to the director of military equipment and Raymond Purdy has been named supervisor of contract administration.

General Motors Corp., Packard Electric Div.—Robert M. Cashman has been promoted to director of production control and purchasing.

Bohn Aluminum & Brass Corp.— James R. Dissette has been promoted to manager of Plant 12, South Haven, Mich. Divco-Wayne Corp., Wayne Bus Div.—Harvey Leventhal has been promoted to operations manager.

United States Rubber Co., Tire Div.—Dr. Robert A. Merrill has been named director of product development.

Consolidated Diesel Electric Corp.

—Everett S. Winslow has been promoted to superintendent of the Schenectady, N. Y., plant.

American Motors Corp. — A. J. Junker has been appointed chief quality engineer, automotive engineering staff.

Ross Gear and Tool Co., Inc., Lafayette Div.—Ralph M. Lehman has been named general manager.

Necrology

Powel Crosley, Jr., 74, internationally-known industrialist who manufactured the first U. S. compact car in the late 1930s, died March 28 in Cincinnati.

Howard E. Wheeler, Sr., 92, head of a New York motorboat manufacturing firm for 50 years, died March 23 in Fort Lauderdale, Fla.

Prescott M. Hulbert, 96, patent attorney for Henry Ford and other pioneers in the automobile industry, died March 22 in Detroit.

John J. Witzig, Sr., 67, retired technical assistant for production programming and control at the Ford parts and equipment plant in Ypsilanti, Mich., died March 22 in St. Petersburg, Fla.

Joseph F. Keller, 89, inventor of an automatic die-cutting machine used in the mass production of all-steel automobile bodies, died March 22 in Philadelphia.

Norman Leeds, Jr., 59, assistant general manager of the Raybestos Div., Raybestos-Manhattan, Inc., died March 12 in Bridgeport, Conn.

General Motors Corp., AC Spark Plug Div.—James L. Elliott, Jr. (far left), has been named purchasing director and John R. Wilson, Jr., succeeds him as director of production engineering.



RUSSELL, BURDSALL & WARD BOLT AND NUT COMPANY



Technical-ities

By Fred E. Graves

Fastening of "vibration" joints

With static assemblies, your only fastening worry is enough safe load capacity. But with dynamic loading, you also have to guard against loosening.

HIGH THREAD TENSION

You'll find one of the best locking mechanisms within the fastener itself: high thread tension. Obviously, the tighter the fastener, the higher the tension and the better the "lock."

CASE HISTORIES

(1) Textile looms notoriously suffer from vibration. Yet their bolts stay tight without any locking device when highly preloaded. (2) Heavy duty shakers had joint loosening problem which was solved for good when the maker switched to high strength hex bolts torqued up almost to yield strength.

Using split lock washers gives no such guarantee against loosening. It becomes equivalent to a solid washer at a relatively low load level. Once the screw has loosened to the point where the washer becomes a spring, it's too loose for safety.

When you can't fully utilize a high strength fastener, go to a bolt with prevailing torque lock nut; or to a unit that combines high thread tension along with a high off-torque value (such as RB&W's TENSILOCK fasteners—see Bulletin TL-2.)

With vibration joints involving thin gauge or sheet metal, it's better to use a thread-cutting screw, than a machine screw in tapped hole. It gives 100% depth of thread contact for more thread friction to resist backoff.

Some ideas for savings through cold forming



It generally costs less to cold-form a part than to machine it, since there's less scrap loss and more speed. The cold working strengthens the part, too—improves its physicals.

These four cases show what happened when designers and production men referred their needs in special parts to RB&W.

- Ball-head stud. Formerly produced on screw machine, this truck mirror pivot suffered high scrap loss, cost 75% more than it did when RB&W produced it by cold forming and some secondary machining.
- Spacer. Cost of this automobile trunk hinge spacer was cut 50% when RB&W cold-formers took on the job of pounding them out at high speed, finely finished and ready for installation.
- 3. Taper plug. Time and money were both saved by manufacturer of expansion bolts who came to RB&W to make these parts. Cold headers formed them faster than screw machines, and with zero scrap.
- 4. Adjustment cam. Cold forming affords the only economically feasible way to produce this part. Due to its large eccentric and hex end, machining and material costs would be excessive.

These examples typify a range of work from RB&W cold heading and cold forming facilities. RB&W also performs many secondary operations on parts to specification, such as drilling, slotting, knurling, etc. Best way to see whether you have a part that could cost you less is to refer it to RB&W for study. Write Russell, Burdsall & Ward Bolt and Nut Co., Port Chester, New York.

Plants at: Port Chester, N. Y.: Coraopolis, Pa.; Rock Falls, Ill.; Los Angeles, Calif. Additional sales effices at: Ardmare (Phila.), Pa., Pittsburgh; Detroit; Chicago; Dallas; San Francisco.

an Editorial

Counting up the Costs



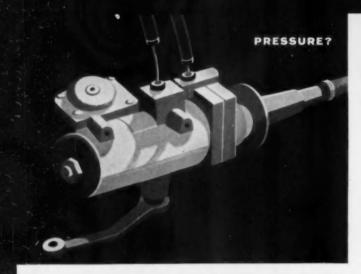
TIMES, THE SIZE AND SCOPE of each segment of the Automotive Industries of America is brought into focus by new data. Unless such figures are studied and reviewed, major advances which have occurred may not be recognized generally. An important compilation of new data has appeared which shows very clearly that these industries in the aggregate spend more on capital goods and tooling than any other industries in the country. This is certainly a very important set of facts.

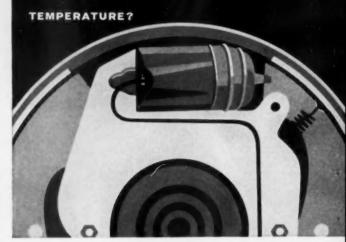
BASED ON DEPARTMENT OF COMMERCE and SEC surveys, the automotive industrial market will spend \$1,450,000,000 on new plants and equipment in 1961. This is 40.7 per cent more than in 1959 and 19.8 per cent more than in 1960. Our estimate of such expenditures for 1962 is \$1.6 billion. The most significant aspect of this information is that it clearly shows how total expenditures have moved ahead despite the ups and downs of the general economic environment during this four year period. By comparison, capital expenditures in other major industries tabulated in the reports are reported as substantially smaller.

THESE DAYS, MANUFACTURERS in the more than 6,200 plants in the automotive industries are reviewing such facts in connection with their long range plans. The financial strength of these companies, on an overall basis, has never been stronger than it is today. Capital is available for sustained additional capital equipment improvement and modernization. It is now estimated that these successful manufacturing establishments will be using between 25 per cent and 50 per cent in new methods and equipment in 1965, beyond those now used in production.

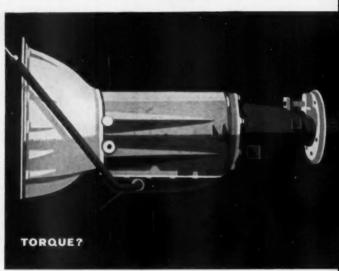
As a General Rule, it is profitable to replace production equipment when the overall savings achieved will amount to 20 per cent or more of current costs, we are told by experts. Summing up this outlook, it seems apparent that the Automotive Industries are in the vanguard of all industries in terms of plant modernization. And they also have developed policies which enable them to continue improvements most consistently on a long range basis. Possibly this is one of the important reasons for the outlook for long term growth reflected by the industry in its expansion plans.

Horry W Baralay
Editor and Publisher









POWER PROBLEMS? . . . "tailored" hydraulic

fluids meet new physical, chemical demands

New developments and designs in hydraulic systems frequently ask for fluid performances that aren't possible with present materials. And that's where the Dow Automotive Chemicals Laboratory can step in and "tailor" a fluid that will meet just about any physical or chemical need.

For many problems, a ready solution is frequently found by improving the existing formulation—for example, adding a thickener to alter viscosity characteristics. Other problems require a totally new material. Here's where the chemist has a special advantage—if he doesn't have the right fluid, he can make it! At the Dow Automotive Lab the chemists and automotive engineers are particularly well equipped to create new hydraulic fluids to extremely exacting specifications.

An example: a new Dow formulation was recently developed for a single

central-power fluid to actuate steering, brakes, windows, and other accessories. To aid the Automotive Industry, the laboratory resources and experience are available to assist in particular problems.

With Dow's broad background in hydraulic fluid technology and a long list of glycols, Dowanol® glycol ethers, and other polyols, a ready answer to many hydraulic fluid needs may be achieved.

ENGINE COOLING. Ebullient cooling for passenger cars is under continuing research at the Dow Automotive Chemicals Laboratory. The increased flexibility of the system is expected to allow more freedom in the placement of radiators, for example, remote from their present location. This thought is intriguing to designers!

VORACEL® foamed-in-place, rigid urethane is showing real economic advantages over cut-and-paste batt applications. Application of the new water and chemical resistant foam may be either by a spray or pour operation for insulation, structural support, sound deadening, "pocket" sealing, and surface protection.

DOW AUTOMOTIVE CHEMICALS LABORATORY

Created expressly to serve the needs of the automotive industry, Dow's Automotive Chemicals Laboratory is active in technical service and development. This laboratory is continually researching and developing coolants, hydraulic fluids, cutting and grinding fluids, functional fluids, fuel and lubricant additives, and synthetic lubricants. To see how this laboratory can be of assistance to you, contact your nearest Dow sales office or write to Chemicals Merchandising in Midland.

THE DOW CHEMICAL COMPANY



Midland, Michigan

Potential Powerplants for Passenger Cars

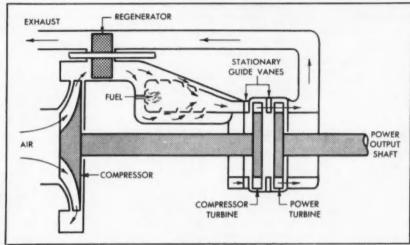


Fig. 1— Automotive gas turbine with regenerator

By John S. Wintringham Ethyl Corporation

Research and Development Dept.

Detroit

HE last decade brought a substantial number of powerplants before the public eye. Some of these were described as being ready to replace the reciprocating gasoline engine in passenger cars. The group includes: Diesel engine; gas turbine; free-piston engine; battery power; fuel cell; Stirling engine; and NSU (Curtiss-Wright) engine.

It might be good to examine the potential of these powerplants in automobiles. If new powerplants are to be used in automobiles, they must compete with the familiar, Otto-cycle, reciprocating engine that has powered cars for many years.

Conventional gasoline engines are compact, powerful, and economical. Methods have been developed to make them in large numbers at low cost. Gasoline engines have a high degree of flexibility in operation. When conditions require a change in speed or load, the engine responds instantly when the accelerator pedal is moved.

Gasoline engines have another kind of flexibility. Their size can be varied over a wide range to fit best the operating requirements. Their efficiency is substantially independent of their size. As engine size is reduced, the ability of a given vehicle to accelerate and to climb hills drops off, but fuel economy improves.

In order to replace gasoline engines in automobiles, alternate powerplants should be competitive with respect to size, weight, power, flexibility, economy, manufacturing cost, and general convenience.

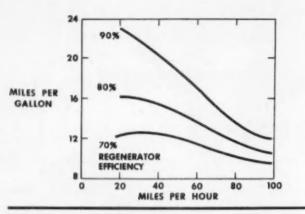
DIESEL ENGINE

Although Diesel engines have been used in trucks and other heavy-duty service for many years, only recently has there been an upsurge of interest in the use of Diesel engines for passenger cars, particularly in taxicabs.

For a given power output, Diesel engines are larger, heavier, and more expensive than gasoline engines. Diesels need more air to burn a given amount of fuel. Diesel engines do not normally run as fast as gasoline engines. Therefore they must be substantially larger. Their greater weight stems both from their larger size and the heavier construction needed to withstand higher operating pressures. Diesels are also less responsive than gasoline engines.

In the case of the Diesel-powered taxicabs now being tested in various parts of the country, the extra cost of the engine requires about 75,000 miles to amortize. Furthermore, to improve economy, smaller and much less powerful Diesels are used in place of larger gasoline engines. Disadvantages which must be accepted include poor acceleration, noise, and hard starting in cold weather.

Diesel engines have a place in



DECEMERATOR 100 H EFRCIENCY = 90% 20 200 MILES PER 16 GALLON 300 12 8 20 40 60 80 100 0 MILES PER HOUR

Fig. 2—Effect of regenerator efficiency on the fuel economy of a 100-hp gas turbine

Fig. 3—Effect of size on gas-turbine fuel economy

trucks, buses, earth-moving equipment, in military vehicles, and in locomotives.

GAS TURBINE

Figure 1 shows schematically an automotive gas turbine. Part of the unit develops hot gases under moderate pressure, and these gases drive a turbine geared to the car wheels. The gas-producing section consists of a centrifugal air compressor, a regenerator, a combustion chamber, and a turbine which drives only the compressor. This unit has to be cranked up to about 15,000 rpm by a starting motor before enough hot gases are available to keep the compressor going. Above that speed, feeding more fuel into the combustion chamber provides more hot gases to turn the compressor and power turbines. At full power, a typical unit will have a compressor speed of 50,000 rpm.

A turbine's rate of acceleration is sharply limited by the temperatures its parts can stand. If fuel is added too fast, that temperature may be exceeded.

Because the efficiency of a gas turbine is improved as the maximum temperature is raised, the use of special, high-cost alloys appears unavoidable. And to be even reasonably efficient, a gas turbine must have a regenerator to transfer heat from the exhaust gases to the compressed air.

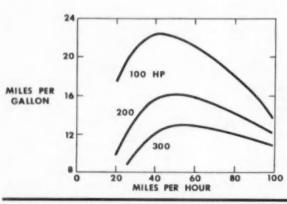
Gas turbines are relatively simple, and they have a high stall torque. Thus they require a less complicated transmission. However, they require a long time to crank, they accelerate slowly, and they are costly if we try to make them efficient

It is possible to calculate the fuel economy of a turbine-equipped automobile with a high degree of accuracy. To be conservative, we assign efficiencies to the turbine components that are higher than would be likely in mass-produced units.

Figure 2 shows how important an efficient regenerator is to the car's fuel economy. If the regenerator is only 70 percent efficient, instead of 90 percent, fuel economy at 40 miles per hour drops from 20 miles per gallon to $12\frac{1}{2}$. With no regenerator, the fuel economy would be about 5 miles per gallon.

Figure 3 shows how the fuel economy of a gas turbine car varies with the size of the turbine. Here, the high regenerator efficiency of 90 percent has been assumed. At 40 mph, a 100-hp unit gives 20 mpg, but a 300-hp unit gives only 14.

Gas turbines should find a place in some truck and bus operation, in earth-moving equipment, and in some military vehicles.



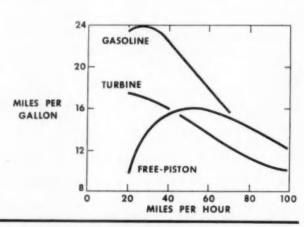


Fig. 5—Effect of size on the fuel economy of a free-piston engine

Fig. 6—Fuel economy comparison of 200-hp gas turbine, free-piston, and gasoline engines

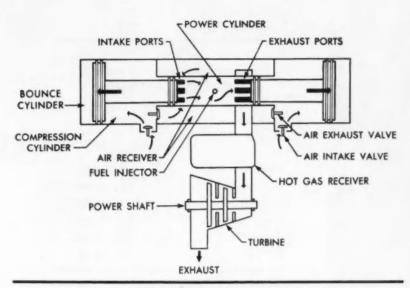


Fig. 4-Free-piston engine



Figure 4 shows a free-piston engine. The unit produces hot gases at moderate pressure, and these gases are used to drive a power turbine geared to the car wheels.

Hot gases formed by diesel combustion of fuel in the power cylinder force the pistons outward, compressing air in the bounce cylinders at each end. The outward piston movement also draws air into the air compression cylinders. Pressure built up in the bounce cylinders is great enough to halt the outward movement, and to return the pistons to inner dead center. The inward movement also compresses air, and delivers it to the air receiver.

In the engine shown here, combustion gases exit as the righthand piston uncovers the exhaust ports during its outward travel. Next, air enters as the lefthand piston uncovers intake ports. Some of the intake air flows thru the cylinder and out the exhaust ports before the pistons bounce back to cover these ports. This air joins the combustion gases to drive the power turbine.

Free-piston engines are heavy, noisy and relatively expensive. They are hard to start in cold weather.

The fuel economy of an automobile equipped with a free-piston engine can be calculated. However, the computations are much more time-consuming than those for the

gas turbine. Ethyl is indebted to Professor London of Stanford University for the methods of computation. Here again we assume high efficiencies of components in order to be conservative.

Figure 5 shows the fuel economy of a car equipped with three sizes of engine. If the free-piston engine is designed to produce 100 hp, the fuel economy at 40 mph is 23 miles per gallon. With a 300-hp unit, however, fuel economy at 40 mph is only 12 mpg.

It is very interesting to compare the fuel economy of the gas turbine or the free-piston engine with that of the gasoline engine. Such a comparison is made in Fig. 6. All three units have the same power output, 200 hp. The relative fuel economies would be similar at any other power

The gasoline engine is substantially more economical in the normal car operating range. The advantage is so large that the gasoline engine can use a fuel which costs more, and still deliver more miles per fuel dollar.

Free-piston engines will power ships and locomotives.

BATTERY POWER

Considerable performance data have been released on one typical contemporary battery-powered car. Its range before recharging is 80 miles on level ground, and about 50 miles over hilly ground. The car

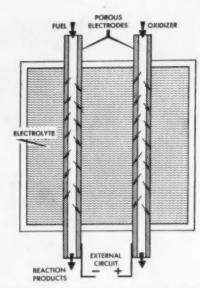


Fig. 7—Schematic of typical fuel cell

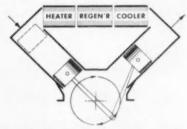


Fig. 8-Schematic of Stirling engine

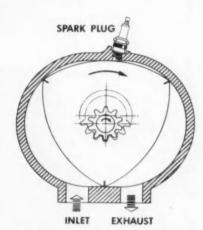
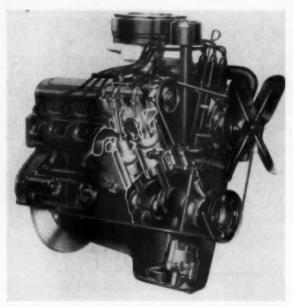


Fig. 9-NSU (Curtiss-Wright) engine

costs \$2800 and has 6.4 horsepower. In contrast to this low power is the 36 hp of the Volkswagen. The limited driving range and the time required for recharging make battery-powered cars unsuitable as a family's main car. These factors and the high cost would seem to limit their appeal as a second car.

(Turn to page 88, please)



Three-quarter cut-away view of Comanche tour-cylinder

Brief Mechanical Data IHC 4-152 OHV Engine

| Bore (in.) | 31/8 |
|-----------------------------------|-----------------|
| Stroke (in.) | 37/32 |
| Displacement (cu in.) | 151.84 |
| Compression Ratio | 8.19 to 1 |
| Bhp (max) | 93.4 @ 4400 rpm |
| Bhp (net) | 86 @ 4400 rpm |
| Torque (lb ft) Max | 142.7 @ 2400 |
| Torque (Net) | 137.3 @ 2400 |
| Firing order | 1-3-4-2 |
| Recommended maximum speed | 4800 rpm |
| Weight, complete with accessories | 542 lb. |

Four-Cylinder Engine Components Machined on V-8 Engine Lines

ROM the standpoint of the engine builder there are important economies in the newly evolved principle of splitting a V-8 in two in order to produce a four-cylinder engine for a lower powered vehicle. In the first place. in a mass production plant it is perfectly feasible to machine components of the four over the transfer line originally installed for the V-8. This reduces initial investment to a very modest figure. Besides this there is a large saving in engineering cost; and an important gain all around in the fact that many components of the four are completely interchangeable with those in the V-8.

This is precisely what was done at International Harvester Co. in launching the Scout vehicle. For the 152-cu. in. powerplant represents the right bank of the Harvester 304-cu. in. V-8. Brief mechanical specifications of the

By Joseph Geschelin

DETROIT EDITOR

four are given in tabular form here.

The major parts affected in this maneuver were the cylinder block, crankshaft, and camshaft. The cylinder block required some new pattern equipment and, as illustrated, the four cylinder block casting in the rough is provided with arms on the left side to permit processing through the transfer machine as if it were a V-8. The arms later are sawn off the casting.

The transfer machines required suitable changes and additions to the electronic control system to permit the two blocks to be put through in batches. How this was done will be described later. There is considerable interchangeability of parts between the V-8 and the Four, among the most prominent being pistons and rings and pins; connecting rods; cylinder head and valve mechanism; and accessories. The Four retains the same valves, valve seat inserts, Roto-Cap valve rotators for exhaust valves, and hydraulic valve lifters.

It can be readily seen that this Four is quite exceptional since it embodies the major features of a heavy duty truck V-8. As a matter of fact, the Four easily passes the 1000-hour endurance test with wide open throttle, full load. Judging by this its life should exceed the life of the vehicle in any owner's hands.

Necessarily the crankshaft had to be designed specifically for the Four. It is a forged shaft of flat type with five main bearings, internally balanced and used without a vibration damper. This was accomplished by employing massive counterweights, the weight and location of these being determined by aiming at the very minimum of bending loads.

In the process the bearings too were changed. Main bearings are of precision type, steel-back with aluminum lining. Connecting rod bearings too are of steel-back aluminum type.

One of the noteworthy features developed for this engine is an aluminum intake manifold, designed to serve as a transfer for the cooling system fluid, thus being definitely of water-heated type. This water-jacketed manifold profiting by the excellent heat exchange properties of aluminum, has been an aid in effecting fuel economy as well as maximum power output.

The engine is fitted with a 12-volt electrical system and is mounted in a three point rubber suspension.

The Holley carburetor used on this engine is of single-barrel, down-draft type, fitted with an oil bath air cleaner.

In view of the novelty involved in adapting V-8 engine foundry practice and transfer machine equipment for the four cylinder engine as well, it may be of general interest to note just what was done to place the single bank engine in production.

In developing the program for the four cylinder crankcase casting, every effort was made to simplify foundry practice. Since the molding and core-making problems were very similar to the V-8 which was already in production, many of the technical problems had already been worked out. Gating and venting practice was already tried and proved, and was duplicated on the four cylinder casting.

Pattern equipment was so designed that flasks for the V-8 crankcase could be used on the four cylinder crankcase. Also, the core assembly trays for the V-8 castings could be used for the assembly of the four cylinder castings. These two items saved considerable capital expenditure on

the four cylinder program.

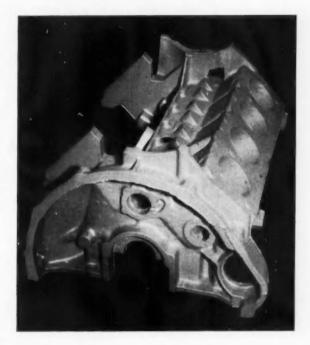
The water jacket core also was made common with the V-8 and required no capital expenditure.

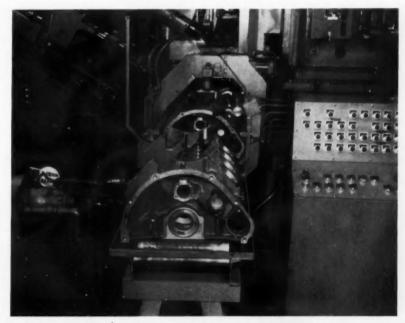
Brass cope and drag (2 in a mold) patterns were made, and after sample castings were approved the brass patterns were chrome plated to resist wear.

Here is a brief description of the manner in which the single bank cylinder block for this engine was adapted for processing over the V-8 transfer machine line.

Castings are produced that are (Turn to page 400, please)

Cylinder block casting for the 4-152 before machining. Note the two arms cast-in as part of the block for register in the V-8 fixtures. They are equivalent to the face of the left hand bank





View taken in one of the stations of the W. F. & John Barnes Transfer machine. By this time the face of each arm has been milled to a finish and serves to locate the casting accurately in the machine fixtures. Later on these arms are cut off.

DESIGN FEATURES

of the



BUICK SPECIAL

and the OLDS F-85 ALUMINUM ENGINES

THE new Buick Special and Oldsmobile F-85 aluminum V-8 engines are basically the same in physical dimensions, including internal size. Both have a bore of 3.5 in. and a stroke of 2.8 in., for a total piston displacement of 215 cu in.

The Buick Special engine has a compression ratio of 8.8 to 1, while the Olds F-85 engine has a c.r. of 8.75 to 1. The Buick engine is rated 155 hp at 4600 rpm, and its maximum torque is 220 lb-ft at 2400 rpm. The Olds engine is

Although Both Have the Same Basic Structure, Designs of Major Components and of Detail Parts Are Not Identical for the Two Engines

rated 155 hp at 4800 rpm, and maximum torque is 210-ft at 3200 rpm.

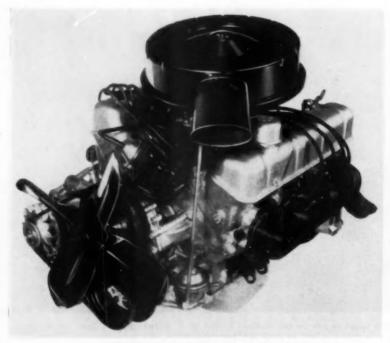
Aluminum cylinder head and block castings for both engines are produced by GMC's Central Foundry Div. at Defiance, Ohio (see AI of Dec. 1, 1960, page 41). Despite the likenesses in overall size, basic structure, output, and source of manufacture, some of the design details nevertheless do vary between the two makes of engines. Even though two separate company divisions are involved, these variations are interesting to the extent that they indicate different thinking on the part of engineers within the same corporation.

At the International Congress and Exposition of Automotive Engineering—sponsored by the Society of Automotive Engineers, and held in Detroit last January papers describing the new Buick and Olds engines were presented.

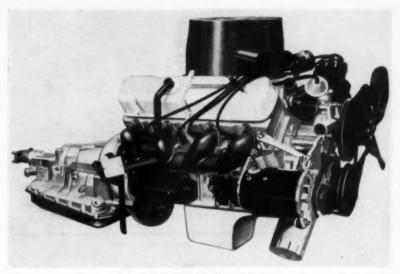
The paper on "The New Buick Aluminum Engine" was co-authored by J. D. Turlay, E. H. Holtzkemper, and C. G. Studaker of Buick Motor Div., GMC.

The paper on "The Oldsmobile F-85 Aluminum Engine" was coauthored by Gilbert Burrell and Frank Ball of Oldsmobile Div., GMC

Several "quotes" from these papers are being presented below to demonstrate where the two engines differ in certain design fea-



Buick Special aluminum V-8 engine



Oldsmobile F-85 "Rockette" engine

tures and, principally, to supply details beyond those previously published in AI. This will supplement the data in AI issues of September 15 (page 72), October 1 (pages 35 and 39), December 1 (pages 33 and 41), and January 1 (pages 38).

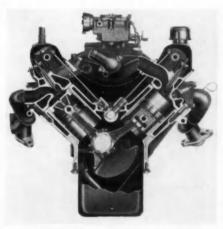
Aluminum Parts

Buick-Aluminum castings are utilized wherever possible in the interest of the maximum weight saving. The cylinder block and cylinder heads are made by the semi-permanent mold process due to the necessity for sand water jacket and port cores. The intake manifold is made as a sand casting. Die castings include such components as: timing chain cover, water pump cover, water pump impeller, water outlet, flywheel housing, oil pump cover, rocker arms, rocker arm shaft brackets, distributor body, starter and generator end frames, carburetor throttle body, and oil pressure indicator switch housing. The pistons, as in most automotive engines in use today, continue as full permanent mold castings.

Combustion Chambers

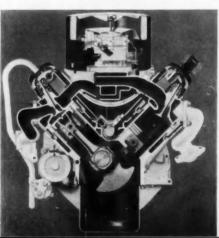
Buick—The combustion chamber finally chosen is formed by a slanted, elongated saucer shape in the cylinder head accompanied by a shallow circular depression in

the piston dome (Fig. 1). Piston coverage of 15 per cent is provided by a 0.35 in. wide land



Transverse cross-section of Buick aluminum V-8

Transverse cross-section of Olds F-85 aluminum V-8



around the top of the piston, adding to the turbulence of the swirling fuel-air mixture leaving the slightly offset inlet port. The spark plug is centrally located, being only 0.404 in. from the cylinder centerline, which results in a short, uniform flame travel to all parts of the chamber.

The new design combines the low-surface-to-volume ratio advantage of the hemispherical chamber with the turbulence of the wedge-type chamber for excellent mechanical octane characteristics. This permits operation with deposits at compression ratio of 8.8 to 1 on 92 Research octane fuel without trace knock. In addition, this chamber includes an in-line valve arrangement with minimum shrouding of both inlet and exhaust valves, providing a high degree of breathing efficiency.

Olds—The "Rockette" combustion chamber is the same wedgeshaped chamber that has been featured on all Oldsmobile V-8 engines since 1949.

As can be seen in Fig. 2, this basic chamber has been modified through the years to reflect higher compression ratios, but retains the turbulence volumes conducive to lower octane requirements and high efficiency. The valves also remain unshrouded for free breathing.

Cylinder Heads

Buick—An interesting feature of the cylinder head is the use of a one-piece water jacket core, eliminating a pasted core sub-assembly and reducing the number of cores required from the core room. This one-piece core also results in more accurate control of wall sections and eliminates undesirable fins in the water jacket area.

The water jacket core is designed to eliminate a maximum amount of unnecessary water, while providing excellent cooling for such critical areas as inlet and exhaust valve seats, exhaust valve guides and spark plug bosses.

The elimination of the water jacketing over the inlet ports per-

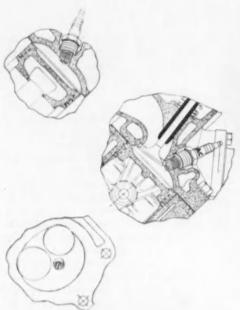


Fig. 1—Combustion chamber of Buick engine

mits an open construction on this

side of the cylinder head for a

lightweight casting. Overhead lu-

bricating oil drains freely through

Both inlet and exhaust ports (Figs. 3 and 4) are streamlined to

reduce to a minimum the resis-

good, attributable in part to the

excellent thermal conductivity of

the aluminum head and the water

jacketing around the valves. Sepa-

rate, pressed-in place alloy iron valve guides are also used to com-

Olds-The cylinder heads (Fig.

5) are cast of the same 356 alumi-

num as used in the cylinder block.

Sand cores are used for the water

jackets and ports, and metal molds are used for the remainder.

used as cast and are extremely ac-

curate because of the metal mold

The combustion chambers are

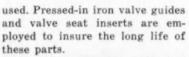
plete the cylinder head assembly.

this area to the cylinder block.

quirements.

used. Pressed-in iron valve guides and valve seat inserts are em-

1949 ROCKET



these parts. The cylinder heads are attached to the block using six 7/16 in.

Fig. 2-Olds combustion chamber comparison



Fig. 4—Buick exhaust port

tance to flow of both the incoming fuel-air mixture and the departing exhaust gases. The exhaust port is kept short to reduce heat rejected to the cooling water and the elimination of the conventional exhaust crossover ports further minimizes the cooling re-Valve seat inserts of alloy cast iron are employed and are assembled into the cylinder head by a shrink fit process. Both valve and seat insert life have been very

bolts per cylinder to reduce bore distortion and insure reliability of the 0.020 in. thick embossed steel head gaskets.

1961 F-85 ROCKETTE

1961 SKY ROCKET

Fig. 3-Buick inlet port

Studs are used to attach the exhaust manifolds to the cylinder heads to prevent loosening due to the constant thermal expansion and contraction. The cylinder heads are symmetrical and can, therefore, be used on the left or right side of the engine.

Valve Mechanisms

Buick-The alloy iron camshaft is driven by a 3/8 in. pitch chain through a sintered iron crankshaft sprocket and a cast iron camshaft sprocket (Fig. 6). Hydraulic valve lifters are used with both Synchromesh and automatic transmission engines. Push rods are made of 1/4 in. steel rod, upset and hardened at both ends.

Die cast rocker arms similar to those introduced on the 1960 Buicks are employed to further extend the application of light metals to this engine. Inserts are installed at each end of the rocker arm, with the ball seat for the push rod being of sintered iron and the valve tip pad an upset steel insert.

Inlet valve diameter is 1.500 in. and the exhaust valve diameter 1.3125 in. Both valve stem diameters are basically 0.340 in. with 0.0005 in. taper in the length of the stem-being smaller at the

Olds-The camshaft is made of cast iron and flame-hardened to guarantee long life. The timing

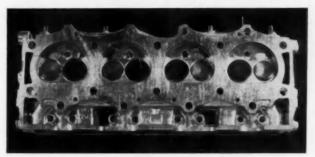


Fig. 5—Olds cylinder head

chain sprocket, oil pump and distributor drive gear, and fuel pump eccentric are separate pieces keyed to the camshaft and retained by a flat washer and bolt. The rearward thrust of the camshaft is taken by a thrust collar on the shaft against the front bulkhead. The camshaft runs in the cylinder block on five replaceable babbit bearings.

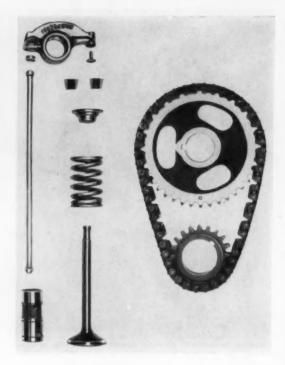
Hydraulic valve lifters are used in the "Rockette" engine as in all Oldsmobile engines. The lifter construction consists of a steel body with a hardened cast foot for long wear. Spring loaded ball check valves are used to reduce valve pump-up. The valve push rods are ¼ in. diameter steel, upset at the ends to form a 3/8 in. diam ball.

Cast iron rocker arms are used to maintain valve train rigidity and, therefore, keep valve pumpup speeds high without excessive valve spring loads. The rocker arm ratio is 1.6:1. The tubular rocker arm shaft and the camshaft are phosphate coated to facilitate break-in and reduce wear. Rocker shaft brackets are die-cast aluminum and each is held to the cylinder head by a cylinder head to block bolt.

The "Rockette" valve springs are wound in conical shape and installed with the small end at the valve and the larger end at the cylinder head. This conical shape means that no two wire coils in the spring are the same length and, therefore, each has a different natural frequency of vibration putting spring resonance periods at very high frequencies.

Because the upper end of the conical spring is small in diameter, the spring retainers are also

Fig. 6—Buick valve train and drive



small, reducing the inertia of this part of the valve mechanism.

Rubber "umbrella" type valve stem seals are used to control oil at this point, and prevent excessive oil consumption and exhaust smoking.

The intake valves are made of alloy chrome-nickel steel. The exhaust valves are of chrome-nickel-manganese alloy steel. These alloys were used to maintain valve stability at high temperatures and insure long life. Valve stems are 11/32 in. diam, and the intake head is 1½ in. and the exhaust 13% in. to insure free breathing. Valve seats are ground on a 45-deg. angle.

Intake Manifolds

Buick—The intake manifold is the only completely sand cast component due to the complexity of coring in a V-8 manifold and to the more flexible nature of the sand casting process.

The branch size of the manifold was made as small as possible, consistent with good breathing characteristics, to provide a minimum manifold volume for instant response under changing load conditions.

The intake manifold heat is through which all the engine coolant flows. This results in a rapid rate of warm-up due to (Turn to page 106, please)

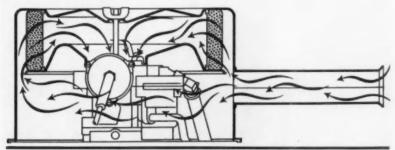
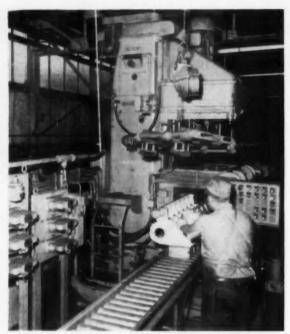


Fig. 7—Olds carburetor cover and air cleaner



Loading a vertical multiple spindle drill from a conveyor

Retooling the Cylinder Block Line at Deere's Waterloo Works

PART II

By Kenneth Rose

MID-WEST EDITOR

ALINE of modern machine tools handles the production of cylinder blocks for the new John Deere tractor engines at Deere's Waterloo Works. These engines, four- and six-cylinder models in Diesel, gasoline, and LP gas types, replaces the two-cylinder horizontal engines that were long a

feature of the Deere tractors. Flexibility in performance is a characteristic of these new engines.

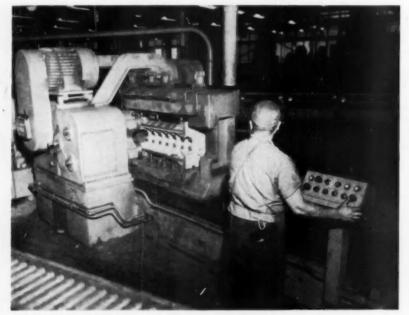
Cylinder blocks for the new engines are cast in the gray iron foundry at the Waterloo plant. After chipping and cleaning, the castings are machined on the block machine line, located on a ground

floor level, then move to the fifth floor of the assembly building on a chain conveyor. Blocks for the four-cylinder and six-cylinder engines are machined on the same line, consisting of 33 machine tools. The description here is for the fourcylinder Diesel block machining.

In the first operation, the frame mounting pads on both sides of the block, and three pads used for locating and functional mounting on the upper right side of the casting are milled on a Cincinnati milling machine. Then, in another Cincinnati milling machine, the top face is rough and semifinish milled, the bottom face rough and finish milled. and the main bearing seats are rough milled. Two locating holes are then drilled, chamfered, and reamed to 3/1 in. diameter, and one 29/32 in. hole is drilled, all on a Natco drilling machine.

Before going to the Natco threeway boring machine for the next operation, the casting goes to an inspection fixture to check for boring bar bushing clearance. The halves of the main bearing bores are then rough bored, the camshaft bores are rough bored, and auxiliary drilling heads mounted on the machine drill an 11/32 in. hole in the side of the block and miscellaneous holes in the back of the workpiece. Front and rear faces

A special low-bed duplex mill machines the top face, bottom face, and main bearing cap seats of the cylinder block



are then rough and finish milled on a Cincinnati High Powermatic miller.

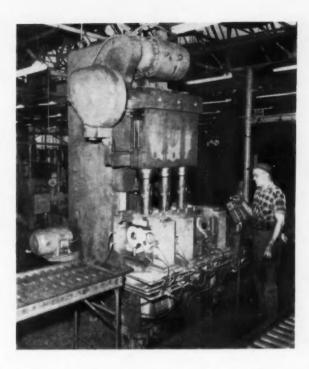
To obtain bushing clearance in the push rod cavities, these are drilled out with a core drill. The same operation drills 14 holes, 31/64 in. in diameter, in the top of the casting, and seven miscellaneous holes in the left side. A Natco two-way drilling machine is used for these operations.

This engine in the Diesel model is of the wet cylinder liner type. In the next operation the four cylinder bores are rough and semi finish bored, and rough counterbored to 5.071 in. diameter. A Moline boring machine is used for these operations. The machining sequence consists of two boring cycles with the fixture shuttled twice.

Locking notches are milled in the main bearing bosses on a Natco down feed mill. The five main bearing bosses are then straddle milled, and the oil seal housing face is milled, also on a Natco down feed mill. The injection pump pad is next milled on a Cincinnati special low bed milling machine. The fuel pump pad, and tachometer pad on a 10-deg. angle on the right side, and the starter pad on the rear flange are milled on a special Cincinnati low bed, duplex milling machine.

A series of drilling operations is performed on Natco drilling machines. Dowel holes are drilled in the front and rear faces, along with other miscellaneous holes; the rear face is core drilled for the 31/2 in. starter bore. Miscellaneous holes are drilled from the top at an angle. Chamfering is done on several of the holes in the rear face. Another Natco then takes over, and drills miscellaneous holes in the front, top and rear faces. The third Natco drilling machine in the line drills miscellaneous holes in the top and the right side of the block on an angle. It also reams two dowel holes and taps one hole in rear face. The next Natco drills holes in front, bottom, and left side and one hole on the right side on an angle. In the next operation the 41% in. hole in the front face for the ventilating pump is core drilled,

Cylinder bores are rough - and semi-finish bored in this setup

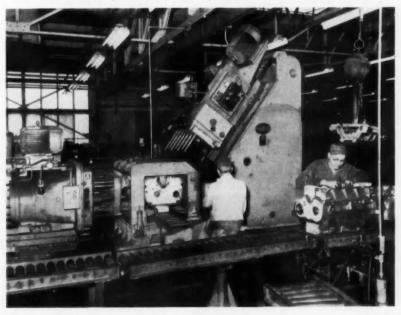


and other miscellaneous holes are drilled in the same setup. The final drilling operation in this series, also performed on a Natco, is the drilling of miscellaneous holes on the bottom face of the block, and counterdrilling the main bearing cap screw holes.

The main bearing cap seats are then finish broached on a Cincinnati machine, and miscellaneous holes on the front, right, top, and rear faces are tapped on a Natco four-way tapper. A second Natco three-way tapper threads the holes for the oil pan and main bearing cap screws, along with miscellaneous holes in the left and right sides, and the bottom.

Conveyors on the line carry the blocks into a Magnus washer, where (Turn to page 98, please)

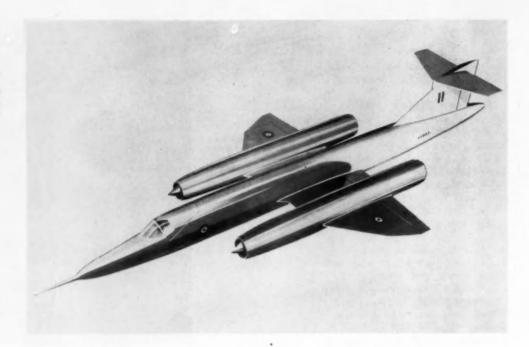
A three-way drill is loaded through a turntable that connects the machine with two conveyor lines and the inspection station at the right



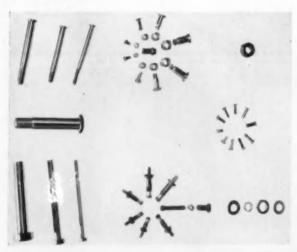
Stainless steel construction accounts for about 90 per cent of the airframe of the Bristol Type-188.

By Norman M. Lloyd

MARKETS EDITOR



Bristol T-188 Probes "Thermal Thicket" with All-Steel Structure



Variety of bolts, rivets, pins and washers made from FV. 448 (AISI 403) for the T-188.

Stainless steel keel boom is torged and machined from single piece of type 403 rolled barstock, 39 ft long. Final length is less than 27 ft.

PECIFICALLY designed to measure flying qualities and aerodynamic heating at hypersonic speeds, Bristol Aircraft's Type-188 is expected to bring back the "numbers" for a new generation of Mach 3 commercial jetliners.

Larger than most "X" machines, the new British aircraft is 71 ft long, with a span of 35 ft. Initially powered by two de Haviland Gyron Juniors, each rated at 14,000 lb static thrust with afterburner, the wing-mounted nacelles will accommodate a variety of engines and intake designs.

The unusual wing has three angles of sweep. Of constant chord between fuselage and nacelle, it is swept back at 38 deg outboard of the nacelles and 64 deg at the tip.

Of particular interest is the extensive use of steel throughout the aircraft. Operating in the atmosphere at speeds above 1500 mph and plagued by skin temperatures

STAINLESS ALLOYS USED IN BRISTOL TYPE-188 SUPERSONIC AIRCRAFT

| | Alloy | Composition | Form | Condition | Use |
|---|----------------------------------|---|-----------|---|--|
| Corresponding American Iron and Steel Institute Designation | Airframe Maker Designation | | | | |
| AISI type 403 | Firth-Vickers FV-448 | 11 pct. chromium (low carbon) Cr - 10.5 pct Co - 0.45 V - 0.15 Mo - 0.65 C - 0.12 | sheet | Hot rolled, hardened and tempered plus milled and skin ground plus cold rolled and stretch leveled (all stress re- lieved before assembly) | skin sections thinner skin sections thinnest skin sections |
| | | | bar | hat rolled | most parts produced from bar stock |
| | | | forgings | forged and heat treated | engine nacelle structur als, 27-ft long kee boom |
| | | | fasteners | fully hardened and tempered | machined rivets cold headed bolts |
| AISI type 321 | Firth-Vickers | 18 pct. chromium, 8 pct. nickel (titanium stabilized) | sheet | cold work hardened (rolling) heat treatment at 840-1025 F. | skin sections (where double curvature forming required) |
| AISI type 420 | Firth-Vickers FV-FI (G) | 14 pct. chromium (titanium stabilized) | sheet | drawn | fastener collars |
| AISI "300 series" | - | austenitic stainless | piping | largely annealed | all hydraulic tubing (landing gear, flaps, power-operated controls) |

up to 536 F, conventional aircraft materials would suffer unacceptable deterioration.

Drawing from a variety of stainless steels in production, Bristol and Firth-Vickers Stainless Steels Limited developed new forms of existing alloys to satisfy the "tight" requirements of the 188.

Researchers settled on Firth-Vickers FV. 448 alloy containing 11 per cent chromium. Used mainly as sheet stock, it is milled or ground to size during manufacture. In bar form, it has a tensile strength of about 156,000 to 190,000 psi, considered adequate for most fittings and forgings. An undisclosed alloy in the range of 200,000 to 268,000 psi is used for wing pick-up forgings and fasteners.

Since most exterior skin sections have compound curvature difficult to produce with FV. 448, a cold-rolled alloy is used. This is a titanium stabilized grade with 18 per cent chromium, and 8 per cent nickel.

Electronic Highway Attacks Vibrations

Hunting for unwanted sound and vibrations in prototype models of future cars, Chrysler Corp. engineers are making use of an electronic highway, the nerve center of which is a nine-room research laboratory.

The attack on the problems of sounds was outlined in Detroit by Joseph R. Farnham, manager of the Chrysler Engineering Div.'s sound and vibration laboratory, in an address before the 15th Annual Technical Convention of the American Society of Body Engineers.

"The nucleus of this facility,"

he said, "is a drive-train analyzer room where a car can be studied for all types of engine and load conditions. The brain which correlates this information is 14 ft in height with scores of dials and meters, over 100 signal lights and a mile of intricate wiring.

Magnetic Shakers

"Flanking this sound and vibration facility are two shake analyzer rooms where subsonic frequencies and audible frequencies are the main studies. The vibrations are supplied by a team of magnetic shakers which can introduce vibrations to any point of a car. They are so powerful they can rock an automobile or they can introduce vibrations so fine as to be invisible to the naked eye. In other words, there is not a single vibration which these shakers cannot duplicate," he said.

Mr. Farnham said that electronic probes pick up the car's hidden rumbles and then feed them into electronic computers for analysis.

"The key advantage of this center is its ability to duplicate any road or drive-train situation with a twisting of the dials. There is no test driver and no human variable to cloud the analysis of different designs," he said.

More Predictable

"These techniques were pioneered by Chrysler Corp. and the most recent developments have made the acoustical characteristics of future automobiles more predictable. However, there is every indication that in many cases chassis resonances are, by themselves, not a problem and they only become a problem when they coincide with passenger compartment resonances.

"Therefore, a better understanding of passenger compartment sounds will make it possible in the future to detune the entire vehicle through minor modifications in the body. To accomplish this it will be necessary to express the whole body structure in a mathematical form.

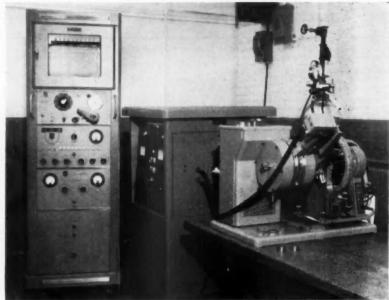
"In the future, the body engineer will be more directly involved in the analysis and correction of all passenger compartment noises. The future will require that he must be an expert in this field."

Autolite Change

The Electric Autolite Co. has announced that it will keep one of its six local plants in Toledo, O. The other five plants will be transferred to Bay City, Mich., as planned.

Autolite officials said the generator and starter plant will remain in Toledo. RLY in 1958 Buick Motor Division acquired what is considered to be the first installation of the modern X-Ray emission spectrometer in an automotive plant. The unit, a General Electric XRD-5S spectrometer, was installed in the metallurgical laboratory for a variety of studies but particularly as a rapid, extremely accurate and reliable control of inprocess materials.

At the same time there arose a need for a similar piece of equipment, exclusively for controlling the gray iron foundry operation. To this end, Buick also acquired an X-Ray emission spectrometer supplied by Philips Electronics of Holland. This is housed in the heart of the foundry in the foundry metallurgical laboratory. It differs



View in Buick foundry laboratory showing the setup of the Philips X-Ray specfrometer equipment. The vacuum chamber for the specimen as well as the goniometer are seen in the foreground.

How Buick Uses Emission Spectrometers for Control of In-Process Materials

from the General Electric unit in one major respect; it is equipped with a vacuum chamber for the specimen, making it capable of accurate readings of indications of the lightest elements present in the melt.

The emission spectrometer is used to analyze materials either qualitatively or quantitatively, with no analytical separations involved, and with minimum sample handling. According to General Electric, certain procedures in sample preparation must be followed to insure reproducible results. Since X-Ray emissions at relatively low voltages do not penetrate more than one mil (varying with the matrix), the surface characteristics of the sample become important.

Generally speaking, for pulverized material, particle size should be at least 90-per cent, -200 mesh to -325 mesh. For massive samples, a polished surface is required with about the same degree of fin-

By Joseph Geschelin

DETROIT EDITOR

ish from specimen to specimen in a series.

Qualitative analysis requires preparation of samples, inserting samples in the sample drawer one at a time, selecting the proper angle on the goniometer, and scaling X-Ray intensity for a predetermined interval or by accumulating the number of photon counts. It may be noted that the goniometer angle must be adjusted to suit each individual element since emissions occur at a specific angle for each element. The values corresponding to the spectrum of elements are given in the manual together with the optimum setting for each ele-

If more than one element is sought in the same specimen, the goniometer is repositioned for each element and run through for the photon count. Once the routine has been established, the analysis can be run by a technician whose main task is to prepare and insert the sample, and start and stop the analysis.

In the foundry operation, the Philips equipment is employed for rapid analysis of cupola iron for all melts but particularly for brake drums and camshafts. Specimens are scanned for a variety of elements, the following being the most important: silicon, manganese, nickel, molybdenum, chromium, and iron. The procedure is so fast—a matter of minutes to obtain a complete record—that cupola corrections and modifications can be made without interrupting the operation.

In addition to checking for alloys and additions, the foundry also makes periodic analyses of slag as another aspect of quality control. While they look for a variety of things, among the major items of control are SiO, and CaO.

It may be of interest to note that conventional "wet" chemical analysis of slag usually took eight hours or longer—too late to make corrections. Answers had to be found while the iron was still molten. With the new spectrometer slag analysis can be made within seven to 12 minutes.

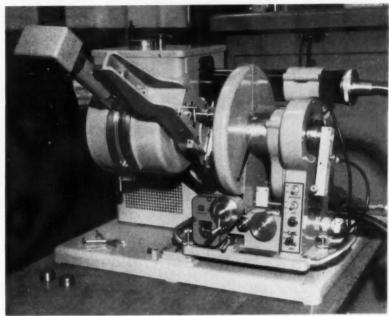
The General Electric equipment is used in the metallurgical laboratory for the many cases where the usual methods of wet chemistry are too time consuming: in structural steel analysis; on tungsten-carbide tools to determine titanium, cobalt, columbium, and tantalum; on tool steels; bearing materials; copper base materials.

Miscellaneous materials such as engine deposits around intake and exhaust valves; slugs taken from carburetor filter bowls; deposits formed in air conditioning lines; and similar contaminents have been successfully analyzed. The conventional wet chemistry methods might have required weeks of painstaking work to achieve the same results.

In one instance, the X-Ray fluorescence procedure made short work of an otherwise time consuming task. This was in the quantitative determination of molybdenum sulfide in lubricants. According to Buick's metallurgist, this was done in less time than it would take a chemist to set up his glassware.

Another useful application was found in evaluating various heat treatments from the standpoint of austenite retention characteristics for spectific alloys and castings.

Obviously the X-Ray equipment holds considerable potential in simplifying the task of the metallurgist and in providing fast results so vital in trouble-shooting.



This is a close-up of the goniometer and specimen vacuum chamber of the Philips instrument.



The General Electric emission spectrometer, the first unit acquired by Buick, is seen here installed in the metallurgical laboratory. Specimen handling and goniometer adjustment equipment are on the bench at the left.

Brake Fluid Bill

The nation's motor vehicle manufacturers have endorsed Federal action to help curb the sale of substandard unsafe brake fluids.

In a statement outlining their views, the Automobile Manufacturers Association suggested that a bill under consideration by a House subcommittee be amended to require that brake fluids shipped in interstate commerce be labeled to show they met specifications of the Society of Automotive Engineers.

The makers also recommended establishment of a technical advisory committee to help develop procedures for procurement of Federal vehicles "incorporating a selected list of available proven safety equipment. They opposed as "unnecessary and impractical" a bill to impose Federal standards on safety features of motor vehicles sold, shipped or used in interstate commerce.



This is the differential carrier for the IHC through-drive tandem axle after all machining has been completed.

Machining Large Differential Carriers at International Harvester Co.

By Joseph Geschelin

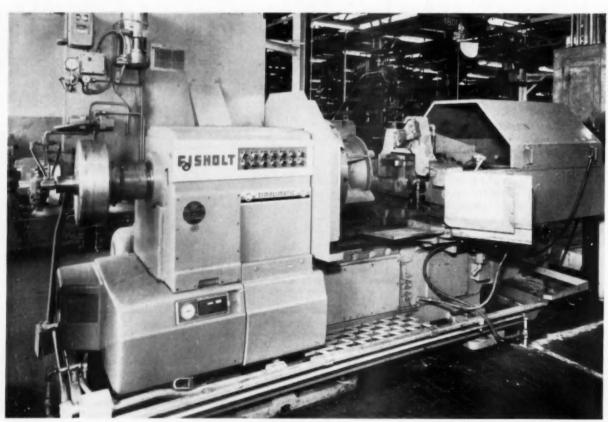
DETROIT EDITOR

o machine the large differential carrier for the new line of through-drive tandem rear axles announced a few months ago.

International Harvester Co. installed the three big single-purpose machines illustrated here.

The first operation, starting with

the raw casting, is in the Gisholt Simplimatic. The work is chucked at the left as shown, machining being done at high speed by means



Initial roughing and finishing operations on the differential carrier casting take place in the large Gisholt Simplimatic seen here. The casting is held in the chuck at the left. The tool block may be seen on the slide at the right.

-Right

Preliminary boring and facing of the carrier are effected in this three-way Natco boring machine.

-Below

Precision-boring and finish facing of the carrier are handled in the threeway Ex-Cell-O machine seen here.

of the individual tools mounted on the tool slide at the right. This cycle handles the following operations: rough- and finish-facing of the pedestals; rough- and finishfacing of the flange; rough- and semi-finish of the register.

Boring and facing them are done in the three-way Natco machine. In this operation, there is a cycle to complete the following steps:

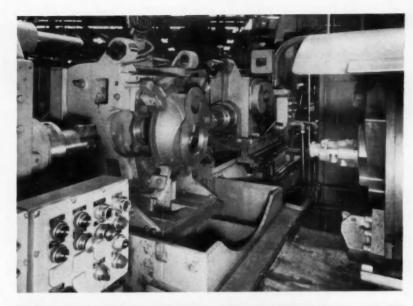
Rough- and semi-finish-bore and chamfer cross holes.

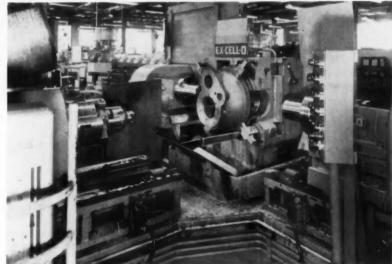
Rough- and semi-finish-bore and chamfer the pinion pilot and bearing cage bores.

Rough-finish-face flat top.

Following these operations the carrier is chucked in the three-way Ex-Cell-O precision-boring machine to finish the same bores and faces. It precision-bores the cross holes; precision-bores the pinion pilot and bearing cage bores; finish-faces the bearing cage mounting face.

All of these machines operate on a fully automatic cycle.





New Nickel Alloy Steel

A revolutionary new 18 per cent nickel alloy steel with unmatched toughness at the highest strength levels of traditional alloy steels has been discovered and developed by scientists of the International Nickel Co., Inc.

The discovery—made at the company's Bayonne, N. J., Kesearch Laboratory—paves the way for a new family of high-strength steels with advanced engineering design possibilities for civilian and defense applications involving exceptionally high pressure and stress.

It is the only known material

which has the ability to achieve a yield strength in excess of 250,-000 psi while maintaining a nil ductility temperature below -80°F. Another outstanding characteristic of 18 per cent nickel steel is its excellent notched tensile strength which exceeds 400,000 psi-(measured under the most severe test conditions with a notch radius .0005"). Tests have shown that this new alloy possesses a remarkable resistance to delayed cracking when exposed to a severe corrosive atmosphere in a highly stressed condition.

The new steel develops its high strength while maintaining ductility and toughness by means of a remarkably easy heat treatment involving age-hardening of martensite. This treatment has been given the abbreviated description of "mar-aging."

Nylon-Rayon Tire

Seiberling Rubber Co. has announced the rubber industry's first tire combining nylon and rayon fabric. Officials say the company has developed a tire with two plies of nylon cord and two of high-tenacity rayon. Nylon is said to give the tire extra strength and rayon provides riding comfort and reduced vibration.



Assembly line of Twin Coach's Special Products Division

UTTING a new plant into operation under normal circumstances requires plenty of advance planning, teamwork, and time. But today's fast-moving economy is forcing vehicle manufacturers to cut production lead time to the very bone.

A case in point is the recent experience of the Twin Coach Company in getting its new Waverly. N. Y., Special Products Division into operation within 65 days after receipt of two new contracts, one for the manufacture of 1000 bodies for American Motors' "Mighty-Mite" vehicle, and a second for the production of 4000 Army ordnance trailers. The "Mighty-Mite" contract stipulated that shipment had to begin nine weeks after award of the contract.

The Buffalo, N. Y., company had been reviewing the possibility of a new plant as part of its diversification and expansion program for the last year and a half. The vehicle facilities at Buffalo were bursting at the seams and the company

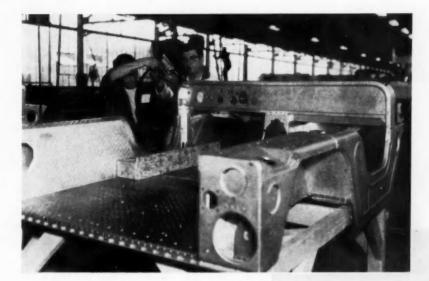
NEW TWIN COACH Started Within 65 Days PLANT

recognized that additional capacity would have to be found if diversification and expansion were to be successful. But the company was taking its time in studying the problem. Receipt of \$3 million in new contracts in July pushed the company into accelerated action.

A quick decision was made to manufacture the "Mighty-Mites" at new facilities. A new plant planning committee, reporting to Manufacturing Vice President Stuart Smith, was set up, under the direction of Production Manager Irving Kaufman, to tackle the problem of

Operations of Receipt of Contract

getting into production in record time. The new plant planning committee was made up of the heads of production engineering, industrial engineering, maintenance, tooling, purchasing and planning departments. It was responsible for formulating and planning the minimum needs of the new facility. Although the company still did not have possession of a new plant, this did not deter the committee from its task of mapping out the new production needs. With each member of the committee bringing his specific knowledge and talents to



Twin Coach foreman (right) is shown training a new employee in assembly operations at Twin Coach's new plant.

Entrance to Twin Coach's new Special Products Division plant, Waverly, N. Y.

bear on the overall problem, the manpower, materials and equipment needs were soon blocked out.

At the same time the committee set about finding a plant that would enable the new division to commence operation in the shortest possible time. This meant that it would have to be close enough to Buffalo to obtain top engineering support from the home office, though otherwise operating as a completely independent facility. With the help of the New York State Department of Commerce, Twin Coach located a building in Waverly, formerly used as a warehouse by a local glass manufacturer, which fitted the bill. The building was 50 ft by 590 ft, and because of its pronounced length, was ideal for Twin Coach's straight line production. The town itself. 180 miles from Buffalo, is serviced by the Lackawanna & Erie Railroad, is close to major trucking terminals, and has an ample supply of labor. Waverly had been in economic doldrums for the last few years, and news of Twin Coach's move was greeted by the community with great enthusiasm. The Valley Economic Development Association pledged its cooperation, and was of great help in expediting the installation of utilities, local purchasing and employment recruiting.

Production boss Kaufman and two assistants arrived in Waverly

on July 15 and set to work. Kaufman is frank to admit that the first three days in Waverly left him with ample doubts of ultimate success, but planning support and generous encouragement from Buffalo headquarters bolstered his spirits. His immediate problem was to clear the plant of cartons which had been stacked from wall to wall and from floor to rafters. It took two weeks to complete this job and with the plant finally empty, the job began in earnest. First water had to be brought in from the street to the building, and power lines and transformers set up to provide the high voltage required by Twin Coach's operation. At the same time machinery, equipment and supplies which had begun to arrive were assembled. planning committee earlier had decided that some of the needed equipment for the new plant should be purchased new. The rest would be transferred from Buffalo. While

sites for the new plant were being explored, the purchasing department secured the new equipment.

Initial equipment included a 90-ton punch press, 50-ton punch press, two 40-ton presses, 10 foot shear, 4 foot shear, 150-ton power brake, two 100-ton brakes, table routers, swing arm routers, high speed drills, a Verson oil-operated rubber forming press, spot welding, arc welding, and heliarc welding equipment, a complete tank line for processing aluminum for welding and painting, paint booths and infra-red lights, and miscellaneous supporting equipment.

By August 15, most of the necessary machinery was assembled and the Special Products Division of Twin Coach was ready to begin fabricating parts and sections, even though production lines themselves had not yet been completed. A week earlier, the first group of pressmen, brake operators, fabricators, as-

(Turn to page 96, please)

Celanese Introduces New Acetal Plastic

A NEW thermoplastic, named "Celcon," is now being marketed by the Celanese Polymer Co., a division of Celanese Corp. of America. The new material is a highly crystalline linear acetal copolymer based on trioxane.

Combining high strength and good processability, it is being offered as a replacement for metals in automotive decorative and functional parts.

Facilities for producing Celcon are currently under construction at a new multi-million-dollar plant located in Bishop, Texas. Developmental quantities are now available from the Celanese plant at Clarkwood, Texas.

The company reports that Celcon has the desirable properties of a high-strength engineering plastic—hardness, stiffness, dimensional stability, light weight, and resistance to abrasion and environmental attack. Field tests have shown that it can be economically injection molded, extruded or blow molded.

The new copolymer is supplied as translucent white, free-flowing pellets, and is presently available in both lubricated and unlubricated grades.

The properties shown in Table I reflect short-term characteristics. Tests were developed originally for metals in many cases, and the results required consideration of the basic difference between metals and plastics with regard to long-term retention of proper values throughout broad ranges of temperatures and environment.

Celcon is unaffected by washing in common solvents such as acetone, ethyl alcohol and lacquer solvents at room temperature. Except for slight color change, it resists strong alkalies up to temperatures of 158 F (Table II). Although resistant to many dilute acids at ambient temperatures, it is attacked by strong acids.

It is stable at molding temperature (230 C for 30 minutes) in the presence of copper, zinc, iron, nickel, lead, brass, and bronze. It can be molded satisfactorily in molds containing copper alloys.

The electrical properties of Celcon compare favorably with those of other thermoplastics used for electrical applications.

Field tests have shown that it can be molded in

TYPICAL PHYSICAL AND MECHANICAL PROPERTIES OF CELCON (1)

| | ASTM Method | Values |
|---|-----------------------------------|------------------------|
| Specific Gravity | D792-50 | 1.410 |
| Hardness, Rockwell M | D785-51 | 76 |
| Ized Impact Strength ftlb./inch of notch 73 F., 50% R.H. -40 F. unnotched | | 1.1 1.0 |
| 73 F., 50% R.H | | 20 15 |
| Tensile Strength, psi. 73 F., 50% R.H., 0.2 in./min. Yield Strength. Break Strength | D638-58T | 8800 8000 |
| % Elongation, 0.2 in./min At Yield At Break | D638-58T | 12 12 40 |
| Modulus of Elasticity in tension | D638-58T | 375,000 |
| Flexural Strength, 5%, psi | D790-59T | 12,000 |
| Deflection Temperature °C., @ 264 psi. | D648-56 | 110 230 |
| Vicat Softening Point °C. °F. | D1525-58T | 110 130 |
| % Deformation under load, 2000 psi., 122 F. | D621-59 | 1.0 |
| Linear Coefficient of Expansion, in./in. F. | D696-44 | 4.5 x 10 ⁻⁵ |
| Mold Shrinkage, range, in./in. | | 0.02 to 0.03 |
| Water Absorption 24 hrs. immersion, % | D570-59aT | 0.25 |
| Coefficient of Dynamic Friction Steel. Brass. Aluminum | Proposed ASTM Weighted Sled | 0.15 0.18 0.20 |
| Tabor Abrasion mg./1000 cycles (1000 gm. load -CS-17 wheel) (100 gm. load -CS-17F wheel) | D-1044-56 | 14 |

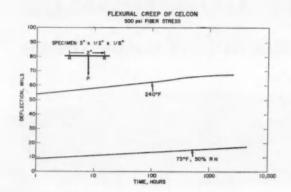
(1) All values determined on 1/8-inch injection molded specimens molded using a material temperature of 410F.

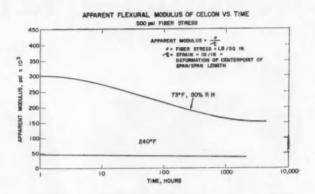
TABLE I

conventional equipment suited for most thermoplastics. Sensitive to moisture and humidity, it should be thoroughly dry before molding (recommended three to four hours at 175 to 200 F in air circulating oven if exposed to excessive humidity).

Extrusion characteristics are similar to other crystalline thermoplastic materials. A temperature gradient of from 350 F in the hopper zone, to 400 F and somewhat higher in the die, may be used.

Celcon may be sawed, drilled, buffed, polished, and machined using tools and speeds similar to those used





for brass. Auxiliary cooling may be required at higher production rates.

Harold Blancke, Chairman of Celanese, says that Celcon is ideally suited for a broad range of applications in some of the new rapid growth areas for plastics. Mr. Blancke estimates the total market for these high-performance engineering plastics, such as Celcon, will reach a level of 200 million lb by 1970.

Anti-Smog Muffler Concern

Formation of the E. J. Houdry Muffler Co. to equip motor vehicles with catalytic exhaust purifying devices has been announced. Gordon P. Larson is president of the new firm, a wholly-owned subsidiary of Oxy-Catalyst, Inc. Specialists in the exhaust field, Oxy-Catalyst, Inc. has been manufacturing catalytic exhaust purifiers for small gasoline engines for 10 years. It plans a new muffler for Diesel engines before the end of the year.

Ex-Cell-O Agreement

Steel Improvement and Forge Co. and Ex-Cell-O Corp. have concluded an agreement which grants Ex-Cell-O exclusive rights to build and market in the U.S. and Canada new metalworking machines utilizing Steel Improvement's electrochemical processes.

New Casting Process

The Arwood Corp., Groton, Conn., has announced a new casting process which can produce intricately-shaped investment castings weighing up to 100 lb. Castings by the new process are now being turned out in actual production runs in virtually all castable alloys.

Previous investment castings made in a solid mold were limited to a size easily held in the palm of the hand. But the Arwood ceramic shell process increases casting sizes, produces parts with more intricate coring and produces shapes which cannot be made by any other method. Additionally, a better and more consistent surface finish is realized.

CHEMICAL RESISTANCE OF CELCON APPEARANCE AFTER ONE MONTH AT 73F AND 158F

| Immersion Medium | 73F | 158F |
|---------------------------------------|---------------|-----------------|
| Air | No change | No change |
| Water | No change | No change |
| Carbon Tet | No change | No change |
| Acetone | No change | No change |
| Toluene | No change | No change |
| Alcohol | No change | No change |
| Gasolene | No change | No change |
| Grease | No change | No change |
| Ethers | No change | No change |
| NaOH (10%) | No change | Discolored |
| H ₂ SO ₄ 4 (3%) | No change | Severe cracking |
| H ₂ SO ₄ (30%) | Disintegrated | Disintegrated |
| HNO ₃ (10%) | Discolored | Disintegrated |
| HCL (10%) | No change | Disintegrated |
| HNO ₃ (10%) | | |

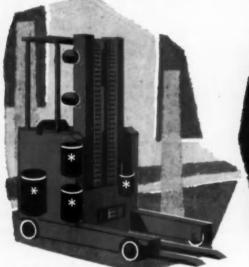
TABLE II



Some of the complex shapes in ceramic shell castings being produced by the Arwood Corp. in regular production runs.

DELCO-REMY CUSTOMIZES

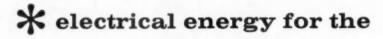
here are a few ways these

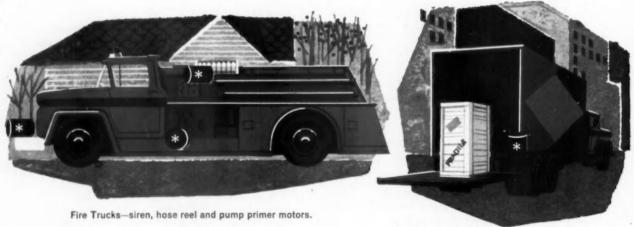


Fork Trucks—power steering pump, high and low lift pump, and propulsion motors.



Buses-heating, defrosting and air conditioning blower motors.





Highway Trucks-power lift gate motors.

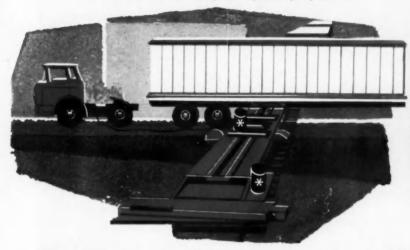
If you have a special power-motion problem, a customized Delco-Remy d.c. motor may be your answer. Like power steering pump and propulsion motors for fork-lift trucks...blower motors for buses...hoist motors for tow vehicles—and many others. Whatever it is, Delco-Remy can fit your design needs exactly! Here's why:

Delco-Remy draws on a complete stock of mass-built components to keep unit cost down. Then, using the skill and know-how of over 40 years, engineers combine components for specific torque, speed and power output requirements. Special provisions can be made, too, for extra high efficiency demands. And every Delco-Remy d.c. motor is built to pass rigid reliability standards.

D.C. MOTORS FOR SPECIAL JOBS

motors can help industry

N.Y.C. R.R. Flexi-Van System-hydraulic pump motors.





Emergency Vehicles-siren motors.

special needs of power-motion



Off-Highway Equipment-remote steering motors.



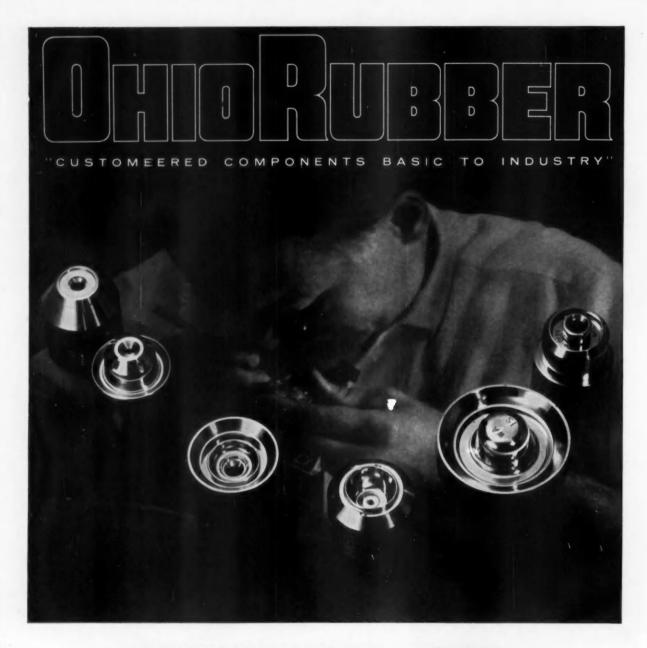
Tow Vehicles-crane, pump and hoist motors.

Delco-Remy has built intermittent and continuous duty d.c. motors for all kinds of off-the-highway use, for high-lift trucks and low-lift pallet trucks, for buses, and police and fire equipment. Is your engineering department writing specs for a special purpose motor on your product? Or would you like to improve your present application? Be sure to consider a d.c. electric motor for your needs. Write Delco-Remy about it. We'll be happy to give you complete data and assistance.

From the highway to the stars

Delco-Remy electrical systems

DELCO-REMY . DIVISION OF GENERAL MOTORS . ANDERSON, INDIANA



STAINLESS STEEL JEWELS

make facsimiles by the million!

OHIO RUBBER can, and regularly does produce 100,000 identical rubber parts per day from one set of production tooling. The jewel-like precision of the self registering molds shown above—actual size—is a key factor in ORCO's high speed, high accuracy, continuous molding process.

AUTOMATIC INTEGRATION of processing steps which are usually handled separately eliminates variables—provides precise control for achieving the ultimate in product uniformity. RUBBER PARTS up to 1½" in diameter and 1" in thickness produced by this process are distinguished by uniformity, minimum flash and precision tolerance of ± .003".

QUANTITY REQUIREMENTS involving not less than 500,000 parts proves

best for this new process.

"DO YOU use small precision molded rubber parts by the million?", if so, the full story of ORCO"CUSTOMEERED" Continuous Molding is yours via free Bulletin CM-100. Send for your copy today to see how custom molded, precision rubber parts can be produced in volume—at less cost.

MP-160



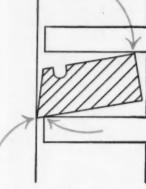
THE OHIO RUBBER COMPANY

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A DIVISION OF THE EAGLE PICHER COMPANY



3 point sealing action



new, for high vacuum engine compression and oil control-

UNISEAL COMPRESSION RING

A new concept in reverse torsion compression rings is now available in the form of a one-piece, cast iron ring with positive side sealing. This new reverse torsion ring is especially valuable in providing oil control in high vacuum engines. The ring is taper-faced with a front groove on top to achieve reverse torsion. Used in the second groove, it effectively seals oil from below, keeping it out of the groove.

The new Uniseal Compression Ring takes its place in the long line of Ramco Ring developments. You may find some of these particularly interesting to you. Your phone call or letter will bring you the full story.

Piston Rings by

TRW

P. O. Box 513 St. Louis 66, Mo.

AUTOMOTIVE GROUP

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LIGHT METALS DIVISION

THOMPSON PRODUCTS THOMPSON PRODUCTS MICHIGAN DIVISION VALVE DIVISION RAMCO DIVISION

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THOMPSON PRODUCTS

Circle 141 on Inquiry Card for more data

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News of the MACHINERY INDUSTRIES

National Machine Tool Builders' Assn. Reports \$10 Million Drop in Net New Orders During February. Biggest Decline Was on Forming-Type Machines After High Month

-By Charles A. Weinert-

Machine Tool Sales Off in February

Net new orders for machine tools declined in February to the extent of about \$10 million below January's totals.

The bulk of the decline was in the forming-type machine sector. Cutting-type machines, as a matter of fact, posted a gain of about \$3.5 million. With respect to forming-type machines, however, the point should not be overlooked that January's sales were unusually high.

NMTBA's preliminary figures for the month of February show that net new orders for both types of machines totaled \$46 million. This compares with January's \$56.1 million, February 1960's \$60.6 million, and the 1960 monthly average of \$54.4 million.

Cutting-type machine net orders in February were made up of \$27.55 million domestic and \$11.75 million foreign, for a preliminary total of \$39.3 million.

The domestic figure of \$27.55 million exceeded January's \$20.95 million and the figures for six 1960 months. It was nevertheless below the 1960 monthly average of \$29.3 million.

February foreign sales at \$11.75 million were similarly above five 1960 months, but under January's \$14.8 million and the 1960 monthly average of \$12.6 million.

Overall, February's domestic and foreign cutting-type machine total of \$39.3 million exceeded January's \$35.75 million and four 1960 months. It also compares with the 1960 monthly average of \$41.9 million.

Forming-type machine net new

orders in February were comprised of \$5.55 million domestic and \$1.15 million foreign, for a preliminary total of \$6.7 million. Domestic and foreign net orders were both below every 1960 month. The total of \$6.7 million was the lowest volume since July 1958—and compares with the 1960 monthly average of \$12.5 million.

However, this decline in February followed a very favorable month. January's \$20.35 million of forming machines was much higher than usual — the 1960 monthly average, as just mentioned, being \$12.5 million.

In addition, domestic forming-machine cancellations in February of \$1.15 million seriously off-set domestic gross order receipts of \$6.7 million. This left net new domestic orders at only \$5.55 million, compared to the 1960 monthly domestic average of \$9.2 million, and January's \$16.7 million.

The \$1.15 million of foreign net orders for forming machines represented a sizable drop from the 1960 monthly average of \$3.27 million and January's \$3.65 million.

Shipments of both types of machines in February amounted to a preliminary \$45.95 million. This total was made up of \$36.05 million in cutting and \$9.9 million in forming machines.

February shipments of \$45.95 million compare with January's \$45.5 million, February 1960's \$51.95 million, and the 1960 monthly average of \$54.3 million.

Around the Industry

Warner & Swasey Co.—Walter K. Bailey, president, told shareholders late last month that the company's machine tool orders increased substantially in February over January, and in March over February. He said, "If the present trend continues, we should experience an upturn in machine tool shipments starting the latter part of the 2nd Quarter. Optimism among contractors and road-builders is also being maintained, and our shipments of construction equipment have already improved." At the annual meeting, Charles T. Blake, director of engineering, was elected a director.

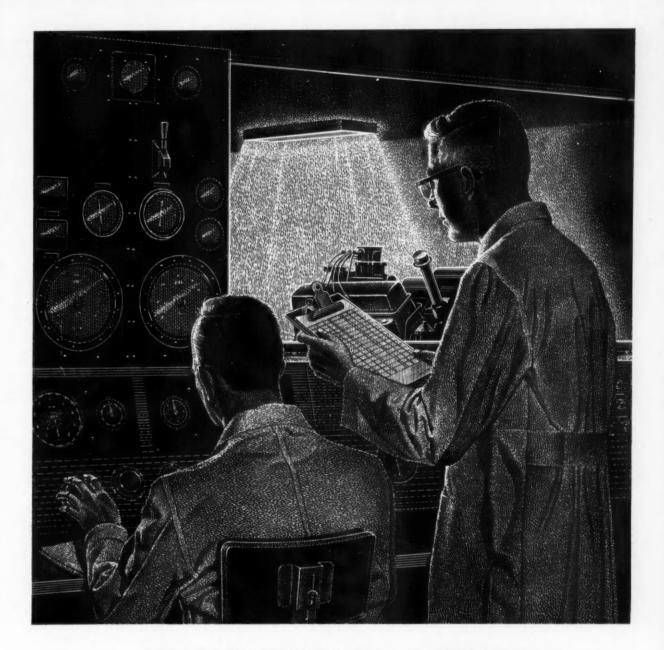
Colonial Broach & Machine Co.—recently shipped a 44-ft-long broaching machine weighing 80,000 lb, said to be the largest machine of this type ever produced in the Detroit area. It will be used for precision-machining of blade root forms in turbine wheels.

Coated Abrasives Manufacturers Institute—reports progress in standardizing the lengths of coated abrasive belts. Proposal calls for manufacture of coated abrasive belts in 31 lengths—in 3-in. increments from 12 through 36 in., and in 6-in. increments from 42 through 168 in.

Universal Vise & Tool Co.—has acquired the standard pump jig and fixture lock product line of Swartz Tool Products Co., which will now be handled by Universal at Parma, Mich. Swartz will continue manufacture of special tooling and fixturing in Detroit.

Burgmaster Corp. — Anttii P. Raiha has been appointed chief engineer.

Norton Co.—George A. Garrison, previously manager of Norton's Santa Clara, Calif., plant, has been appointed purchasing agent of the company.



ORIGINATED BY SEALED POWER...PROVEN IN SERVICE... The best metal for oil rings is Stainless Steel

Back in '53, Sealed Power accepted a challenge... to develop a better oil ring for modern, high compression engines.

Four years later, after time, talent and money were poured into the project... after scores of test engines were dyno-run, Sealed Power engineers and metallurgists proved one thing: the best metal for oil rings is Stainless Steel.

Manufacturers who produce over 85% of all U. S. cars specify Stainless Steel oil

rings for original equipment and for service. More than 50,000,000 have been factory installed.

Why? Because Stainless Steel won't rust or corrode and it resists pitting and etching of gases. The result is greatly reduced carbon build-up and longer ring life.

Sealed Power Stainless Steel oil rings retain efficient tension despite high temperatures, they side-seal, prevent oil pumping. They're proven . . . not experimental.



Progress through Profits

Sealed Tower Preferred Performance

PISTONS . PISTON RINGS . SLEEVES . SLEEVE ASSEMBLIES . SEALING RINGS FOR ALL APPLICATIONS

SEALED POWER CORPORATION, MUSKEGON, MICHIGAN - ST. JOHNS, MICHIGAN - ROCHESTER, INDIANA - STRATFORD, ONTARIO - DETROIT OFFICE - 7-236 GENERAL MOTORS BUILDING - PHONE TRINITY 1-3440

Report from the

FARM EQUIPMENT INDUSTRY

By Kenneth Rose

MID-WEST EDITOR

Ford's New Five-Plow Tractor

A new farm tractor introduced by Ford Motor Co, is the most powerful and the largest which Ford has ever built. It is rated as a five-plow tractor and weighs in excess of five tons when fully loaded.

Seven new implements for fivefurrow plowing and six-row cultivating and planting work are in production for use with the new Ford 6000 tractor. Ford's largest tractors and implements previously were rated in the "3-4 plow" power class.

Features of the Ford 6000 include "Powr - Stor" accumulator hydraulic system, three-point lift linkage with hydraulic lower-link control of implement draft and position, twin - position steering wheel, and electro-luminescent instrument panel lighting.

In addition, the new tractor offers the Ford power-shift Select-O-Speed 10-speed transmission, requiring no clutch pedal and capable of being changed to any gear ratio without stopping; and a completely independent hydraulically engaged two-speed power take-off. Wet-disk hydraulic power brakes, power- adjustable rear wheels, and power steering also are standard equipment.

A new six-cylinder, high-per formance Diesel engine was developed by Ford for the 6000 tractor. With displacement of 242 cu in. and compression ratio of 16.5 to 1, the engine is rated at 85 bare engine brake horsepower, 66 PTO horsepower, and 60 drawbar horsepower. Its drawbar pull is rated at 7000 lb. The bore of the engine is 3.62 in.; its stroke is 3.9 in.

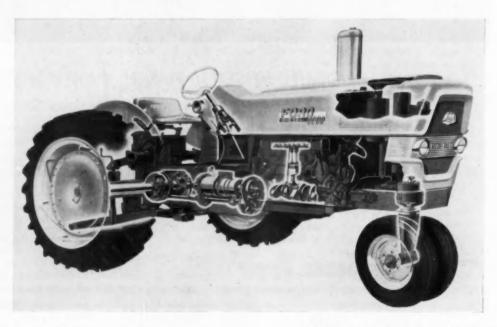
The tractor has a wheelbase of 95 in. and an overall length of 149 in. Three front-axle options are available—two-wheel wide adjustable axle, two-wheel row crop assembly and single-wheel row crop assembly.

Seven Horsepower IHC Tractor

International Harvester Co. announced its entry into the lawn and garden tractor field with its Cub Cadet, a 7 hp model that should be valuable for many farm chores in addition to its primary field of interest, the suburban households. With an overall length of 62 in., overall height of 38 in., ground clearance of 6 in., and turning radius of 6.7 ft, the Cub Cadet has a total weight of 475 lb.

The aircooled 4-cycle engine can be obtained with an electric starter, and has speeds of 1000 to 3600 rpm. Power is transmitted from the engine by a V-belt to a fully-enclosed all-gear drive transmission and final drive.

Major features of the new Ford 6000 tracter are seen in this cut - away drawing. From tracter front to rear are: Heavy cast iron front end, hydraulic accumulator, radiator with large fan bringing cooling air through side grille, six-cylinder 242-cu in. Diesel engine, Select - O. Speed transmission, two-position steering wheel, heavy duty rear axle and lewer-link controlled Category II three-point hitch.





that hasn't been eliminated by Schlegel glass-run channel liners

Annoying car window rattles have been squelched permanently.

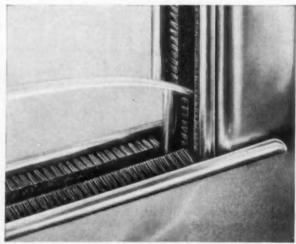
Every moving window in this automobile is snuggled in a channel of deep, silent pile liner by Schlegel. When the windows are moved, they slide effortlessly in a uniformly-dense woven pile, furnished to precise specifications by Schlegel.

Outside noises, too, are muffled by Schlegel pile liners. In rain or wind, the windows are sealed almost hermetically.

This seal is due largely to the resilience of Schlegel pile. It hugs the glass surface evenly, flexing against wavy surfaces to hold a constant seal. This quality pile will retain its wear-resistance for years to come.

Try a sample of Schlegel woven pile liner in your own wear-testing lab. Run it through a few hundred thousand ups and downs. You'll see why Schlegel woven pile stays dense—to smother rattles for years to come.

Specify Schlegel woven pile liners in your glass-run channels. You'll be in good company, for automotive engineers have been specifying Schlegel pile liner since glass windows were first used in automobiles.



This glass-run channel, with woven pile by Schlegel, offers frictionfree, noiseless window movement.



SERVING THE AUTOMOTIVE INDUSTRY

SCHLEGEL MANUFACTURING COMPANY

1555 Jefferson Rd., Rochester 23, N.Y. In Canada: Oakville, Ont.

PRODUCTION and PLANT

PRODUCTION EQUIPMENT

By C. J. Kelly

FOR ADDITIONAL INFORMATION, please use reply card at back of issue

Hydraulic Cylinders

Low pressure cylinders have been developed for application on sys-



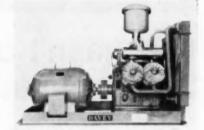
tems that do not require high pressure. The new line is compact in design and has a range of bore sizes from 1½ to 6 in., with pressures up to 1500 psi. a new seal arrangement automatically lubricates the bearing at all times. The units are available with Viton seals and packings for high temperature applications and when special oils are used. Milwaukee Culinder Co.

Circle 40 on Inquiry Card for more data

Air Compressors

Consisting of both single and 2 stage units, a new line of reciprocating air compressors have a range of from 7½ to 150 hp ratings. Both direct connected and V-belt driven machines are available. The single stage compressors are suitable for operation at 50 psi continuous pressure; 2 stage at 125 psi.

Major features are said to include individual cylinders, made of nickeliron alloy with deep radial fins to ensure maximum cooling and lowest possible operating temperatures. Un-



loaders are of suction valve type which hold intake valves off seats when pressure reaches maximum setting. When pressure drops 10 psi, valves are released to operate from an adjustable pilot control valve. Automatic start-stop or dual controls are also available. Davey Compressor Co.

Circle 42 on Inquiry Card for more data

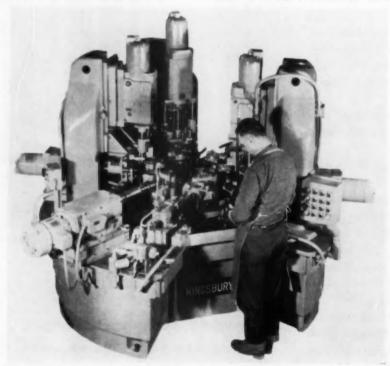
Kingsbury Machine for Speedometer Frame Die Castinas

On this machine for the Ford Motor Co., eight units with nine spindles drill, chamfer, counterbore, ream, tap, and thread at a gross rate of 600 parts per hour. The three vertical units finish one hole, but in the two styles of the work these holes are in different locations. So each unit can be located in either of two positions. There are also five horizontal units that thread a stem, finish the

hole in the stem, and tap two other holes.

A 30-inch index table holds six work fixtures with power clamping and automatic unclamping. A cam actuates equalizing arms that clamp the work back against four rest points. A spring-loaded ram actuates the cam for clamping, and an air cylinder does it for the unclamping.

Circle 41 on Inquiry Card for more data



Multi-operation machine tool built for Ford Motor Co. by Kingsbury

AC-DC Arc Welder

With adaptable auxiliary equipment a new welding unit is reported to be able to handle any type of welding job. This 300 ampere silicon rectifier model TR operates from single phase ac and delivers ac current, or straight or reverse polarity dc, to the welding arc.

It features built-in high frequency equipment for the most exacting tungsten inert gas metal are welding. Intensity is controlled by a stepless rheostat. Water and gas are controlled automatically by solenoid valves. The unit is easily accessible for maintenance with a hinged door exposing all heavy duty industrial re-

lays and a front inspection panel covering the solenoid valves. The rear inspection panel exposes the silicon rectifier assembly and primary terminal connections.



Optional features include wave balance for ac tungsten are applications to improve stability, eliminate "clipping," and balance the cleaning and welding portion of the cycle. An electronic spot welding timer is also available for accurate repetitive timing. Westing-Arc Div., Westinghouse Electric Corp.

Circle 43 on Inquiry Card for more data

Orienting Machine

This automatic feeding and orienting machine, for all types of metal parts, has been designed to eliminate transferring of parts by hand. It is capable of handling up to 1160 pieces

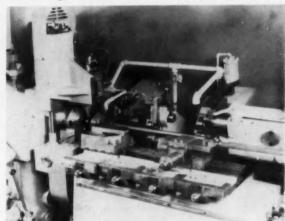


per minute. Parts or materials are received from one machine positioned on the conveyor belt and fed to another machine automatically. Bosworth Mfg. Co.

Circle 45 on Inquiry Card for more data

Machine Combines Rough and Finish Turning Operations

This machine was designed with special tooling to combine all rough and finish turning operations on automobile axle shafts. The operation consists of taking two cuts on the flange faces and at the same time burnishing an oil seal dia. All operations on this unit are completely automatic. The manufacturer reports the total floor to floor time is 1.05 min per shaft. The lathe has been desig nated the model AR Lathe.



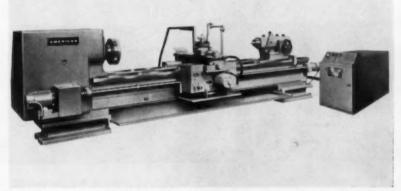
A MAJOR feature of the "AR" lathe is an instantaneous tool relief control mechanism which permits reversing the feed drive mechanism at any time during the machine cycle without disturbing the timing of the slides or the setting of the tools. This is particularly important if a carbide tool is damaged while under cut. All tools may be withdrawn from contact with the work piece, eliminating further tool breakage which would result if the spindle rotation was

stopped while the tools were engaged.

A built-in simplified change-over mechanism permits fast set ups from one job to another without the necessity of changing cams. With the Seneca Falls change-over mechanism, all timing functions may be pre-set by dials graduated in length of cut. Timing of slide and carriage movements are mechanically related thus insuring proper sequencing. Seneca Falls Machine Co.

Circle 44 on Inquiry Card for more data

Engine Lathe for Tape Control Available in 4 Sizes



These new American Tool Works lathes feature a swing over the carriage from 21 to 31 in.

M odels 2010, 2413, 2514 and 3019 are the designations given four new sizes of an engine lathe which was designed for continuous path tape control. Each is controlled by a General Electric Mark Century continuous path control system, using 1 in., 8 channel punched tape.

Three extra-heavy bearings support the spindle, and starting, stopping and braking of the spindle is by control of the main drive motor. All headstock gears are hardened and ground and automatically lubricated by "cascade" oiling.

Double electric clutches operating in conjunction with variable speed motors provide 20 cross feed rates and 20 longitudinal feed rates plus rapid power traverse to the cross slide and carriage. The American Tool Works Co.

(Turn to page 89, please)

Circle 46 on Inquiry Card for more data

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fuel and engine operating range. Records show that vehicles equipped with a SUN "Top-Tach" have longer engine life, reduced maintenance costs and lower fuel bills.

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WELECTRIC CORPORATION

TACHOMETER DIVISION
6373 North Avondale Avenue · Chicago 31, Illinois

Potential Powerplants for Passenger Cars

(Continued from page 57)

FUEL CELL

Figure 7 shows one kind of fuel cell. A chemical fuel and an oxidizer react in the cell to form electricity. This is the reverse of electrolysis, Conversion of energy into power can be as high as 65 percent as compared with 40 percent or so in internal-combustion engines.

In the cell shown here, hydrogen is introduced thru one porous electrode, and oxygen thru the other. Their reaction, which forms water, produces current which is used to power electric motors.

Hydrogen-oxygen cells can operate at normal atmospheric temperatures. Cells using hydrocarbon fuels and air operate at about 900 F. This operating temperature can be reduced by using catalysts.

Allis - Chalmers last fall introduced a fuel-cell farm tractor. The 20-horsepower fuel cell weighed 1900 lb and occupied 22 cu ft. On this basis, a 200-hp fuel cell would weigh 19,000 lb. On a volume basis, a 200-hp fuel cell would occupy 220 cu ft.

Much more favorable volume and weight data have come from other sources. Table 1 shows the most favorable published volume data, and Table 2 the most favorable weight data:

TABLE I

| votame Compa | HOUN |
|-----------------------------------|---------|
| Powerplant Fuel Cell: | CuFt/Hp |
| Cell | 0.18 |
| Electric Motor | 0.10 |
| Total | 0.28 |
| Gasoline Engine & Transmission | 0.25 |

In this comparison, the fuel cell and the gasoline powerplants occupy roughly equal space.

TABLE II

| rison |
|--------|
| Lbs/Hp |
| |
| 8.3 |
| 5.0 |
| 13.3 |
| 3.0 |
| |

In this comparison of the most favorable data, the fuel cell weighs about four times as much as the gasoline powerplant. These comparisons do not include the substantial bulk and weight of the containers for fuel and oxidizer.

Fuel cells may be used in forklift trucks. Improved future units may find a place in space vehicles.

STIRLING ENGINE

Figure 8 shows one arrangement of a Stirling "hot-air" engine. This external combustion engine was invented in 1816 by a Scottish minister. Rather inefficient versions were used in the last century to pump water.

Heat applied to the head of the Stirling engine's cylinder causes air or gas inside to expand at constant temperature, pushing down the power piston on the left. The air then moves thru the regenerator as the displacement piston on the right moves down. Heat is stored in the regenerator, and the air contracts. The air volume is further reduced by cooling at constant temperature in the right-hand cylinder. To complete the cycle, the air picks up heat in the regenerator.

Within the past two decades, Philips in Holland and General Motors redesigned the engine to produce high efficiency. However, this modern engine is expensive. Moreover, it is difficult to change the power output quickly. For equal power output, the Stirling engine requires two or three times as much radiator surface as does a gasoline engine.

For these reasons, the Stirling engine is not attractive as an automotive power plant. It may find use in central power stations.

NSU ENGINE

Curtiss-Wright has acquired U.S. rights to this gasoline engine. As shown in Fig. 9, there are only two major moving parts—a triangular rotor and the crankshaft. As the rotor turns inside the housing, a fuel-air charge is drawn in thru a fixed port, compressed, and ignited when it passes the spark plug. The expanding gases push the rotor around until they can exit thru the exhaust port.

Some part of this sequence is going on at all times in each of the three chambers formed by the rotor's sides and the housing. Thus the engine's operation is virtually continuous intake, compression, expansion, and exhaust. Operating speeds are high; small units are reported to have turned 17,000 rpm.

The NSU engine poses very difficult sealing and lubrication problems. Some qualified American engineers believe these problems are insurmountable when high power output is desired. Some flame quenching has been reported in smaller engines.

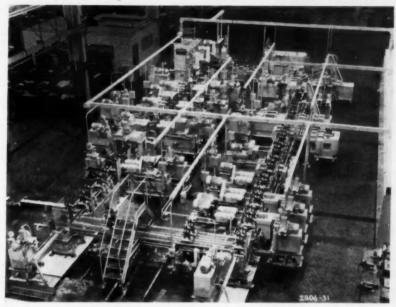
THE FUTURE

Weighing the advantages and disadvantages of these varied powerplants, it does not appear that any other is likely to replace the conventional gasoline engine in passenger cars. What then is going to take place? It appears that the American public is now highly interested in better fuel economy in terms of more miles per dollar.

This trend will develop as more and more imported and compact cars join our passenger car population. It is already affecting the size of engines in the full-size cars, and the weights and dimensions of these cars.

At the end of 1964, it is estimated that cars in use will total 71.4 million, of which 3.9 million will be imports, and 7.8 million U. S. compacts. At the end of 1964, our car population will contain 16.4 percent of small cars.

Irregular Shaped Parts Processed on Transfer Unit



Transfer machine has been designed with inspection stations for in-line checking

A pallet-type Transfer-matic machines power-steering-gear housings,

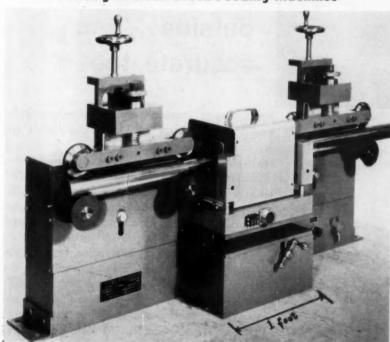
permits in-process inspection and accomplishes assembly operations accurately. Through use of pallets to hold them, the irregular shaped parts need be located and clamped only once during processing.

The unmachined malleable-iron castings are loaded into the pallets at the start of the machine and are processed two at a time around the closed-loop 38-station Transfer-matic. The machine operates on a 24 second cycle. With two parts simultaneously processed in each station, 300 parts per hour are produced at 100 pct efficiency. Because of the operating flexibility of this machine, the user has been able to produce parts at more than the "design" rate.

The accuracy of this machine starts with the precision pallets used to transport the workpieces from station to station. They are of "open" design so that tools have access to all four surfaces of the housings. Rotators are used in two locations to index the pallet 90 deg to expose other surfaces to tools. Pallets are handled two at a time in the machining stations but are individually located and clamped in each. The Cross Co.

Circle 47 on Inquiry Card for more data

Tubing and Bar Stock Feeding Machines



Two new drive units, specially built to feed round tubing and bar stock, automatically Two new drive units, specially built to teed round tubing and bar stock, automatically locate defects in ferrous and non-ferrous products such as rod, wire, seamless or welded tubing and pipe. Constant speed, minimum deviation from the centerline of the coil and easy access to the coils for changeover are features at the units as reported by the manufacturer. The units are designated types X-2316 and X-2366. The X-2316 handles diameters in a range from 1/4 to 4 in., while the X-2366 has a range of 1/4 to 11/2 in. Magnaflux Corp. Circle 48 on Inquiry Card for more data

Limit Switch With Lamp

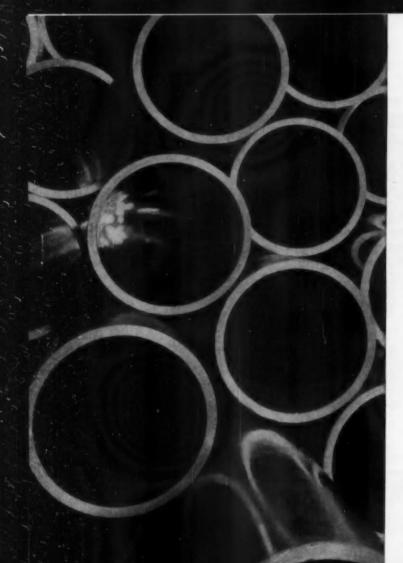
IMIT switches with a built in indicating lamp operate with the light normally on, when the switch is not actuated, and off when it is actuated. Operating the switch, then, flashes the light. The lamp can be in-

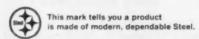


stalled in the switch cover to make contact with either the normally-open or normally-closed contacts of the switch element.

Electrical rating of the switch is 10 amperes, 1/2 hp at 120 V AC. Minneapolis-Honeywell Regulator Co. Micro Switch Div.

Circle 49 on Inquiry Card for more data





Smooth ... inside, outside ... and accurate, too!

For a very fundamental reason, more and more Engineers, Designers and Purchasing Agents are specifying USS National Electric Resistance Welded Steel Mechanical Tubing—it saves money.

Dimensional accuracy and closely controlled mechanical properties insure consistency—consistently low machining losses, uniform strength, low fabrication costs and high torsion resistance—and the tubing is smooth inside and outside.

Whether your tubing application requires the dependability for a load-carrying member or the surface smoothness quality for a hydraulic cylinder, USS National Electric Welded Mechanical Tubing must be your first consideration.

USS National Electric Welded Mechanical Steel Tubing is available in a wide range of cold drawn or hot rolled sizes from as small as ¾" x .028" to as large as $5\frac{1}{2}$ " x .250". Your National Tube Distributors throughout the country will gladly show you how tubing can reduce your costs. See your USS National Tube Distributor.

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NEW

PRODUCTS AUTOMOTIVE - AVIATION

FOR ADDITIONAL INFORMATION, please use reply card at back of issue.

-By C. J. Kelly-

Heavy-Duty Brake

Stopmaster is the name given a newly developed off-highway brake. The manufacturer reports the new unit operates on a totally different "balanced-design" actuation principle that provides equal braking effort by both brake shoes.

This hydraulically acuated mechanism is available in 17, 20¼, 22 and 26 in. diameters, and in 4 to 10 in. widths. The brake is equally well suited for straight hydraulic, airover-hydraulic or vacuum-over-hydraulic actuation. Periodic lubrication of the brake is eliminated since all actuation parts are located internally



and sealed in lubricant. Automatic adjustment is available as an optional feature. Rockwell - Standard Corp., Brake Div.

Circle 60 on Inquiry Card for more data

Terminal Assemblies

New ceramic-metal terminal assemblies for use in electronics gear have been developed. The new terminals are called Cerameterms and are reported to be "practically indestructible." Red Bank Div., Bendix Corp.

Circle 61 on Inquiry Card for more data

Turbocharger

A lightweight turbocharger has been developed for a major producer of Diesel powered equipment. Design features of the model 317, which is the manufacturers designation, include light weight, a simplified bear-



ing design, efficient seal design and easy accessibility for maintenance inspection. Aluminum is used extensively throughout the new unit. Thompson Ramo Wooldridge.

Circle 62 on Inquiry Card for more data

New Aircraft Wheel

Rust-Proof aircraft wheels that will withstand more than 1000 deg of heat have been designed to meet the severe operating requirements of high speed jet aircraft. The wheels are made of titanium. Goodyear Tire and Rubber Co.

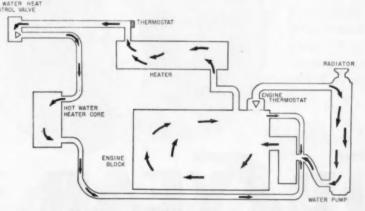
Circle 64 on Inquiry Card for more data

Engine Preheater Designed for Gas or Diesel Units

Quick, easy cold weather starting of any truck, bus, construction equipment or other gasoline or diesel engine is the purpose of a new South Wind Engine Preheater.

The preheater, declared the most practical and inexpensive way to resolve cold weather starting problems, quickly preheats the engine coolant. It circulates the coolant through the block, heating the engine for quick, easy starting, and saving wear on both engine and battery. It automatically maintains the temperature of

the coolant between 140 and 160 deg F, when the vehicle is parked with the engine stopped or idling. Outdoor overnight parking is made practical, even at low temperatures; drivers can turn the engine off during eating or other stops, but engine and cab are kept warm. Construction equipment can be shut down at any time, regardless of temperature, but remain ready for quick starting. Stationary engines will stay warm, ready for rapid starting when needed. Stewart Warner Corp.



New device will keep engine and cab of tractor warm when ignition is off.

Circle 63 on Inquiry Card for more data



What do Goodyear Earthmover Rims have that no others have?

A: MORE times FOUR

- I MORE rims on the job: More tons are hauled on—more earth-moving equipment rides on Goodyear rims than on any other kind. Result: You reap the benefits of the widest, soundest experience in rim design, manufacture and use.
- 2 MORE kinds of rims: Maximum rim performance stems from proper specification. Goodyear makes the only complete line of earthmover rims. Result: The choice that permits you to get exactly the right rim for the job.

What better reasons for choosing Goodyear as your rim supplier? Only these: The desire and ability to design and build any rim that may be needed for tomorrow's earth-moving equipment. No matter what your rim needs or plans, you'll find it pays to call on Goodyear. See your local rim distributor, or write: Goodyear, Metal Products Division, Akron 16, Ohio.

3 MORE rim engineering help:
Goodyear has more engineers designing and selling rims than any other company. And they know tires, too. Result: The help you need in choosing the right rim for top per-

formance-longer tire life.

4. MORE rim "firsts." The first true earthmover rim, the first 5° rim, the first tubeless rim—in fact, every major earthmover rim advance was made by Goodyear. Result: The very latest in rim design and manufacture at work, for you.

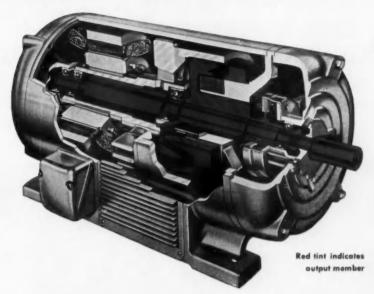


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Extends Capacity Range to 15 HP in the Popular Quill-Type Design

The addition of the new model ACM-905 to the famous ACM-903 and ACM-904 lines of Dynamatic Ajusto-Spede Drives makes the desirable features of Dynamatic Quill-Type design available for many new applications.

Dynamatic Ajusto-Spede Drives provide controlled adjustable speed from an AC power source. Standard control features include on-off clutch control, infinite speed adjustment, constant speed regulation, and jogging. Any of a variety of special features may be easily and economically added to the standard control.

All Quill-Type models are available with either eddy-current, Dyna-torQ, or fail-safe brakes.

An Ajusto-Spede Drive, a control unit (either electron tube or transistorized magnetic amplifier), and a push-button station comprise a compact, easily installed, low-cost drive package.

Check these Ajusto-Spede® Advantages

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- * Wide speed range
- * Remote control
- \star Stationary field coils
- * Excellent performance characteristics

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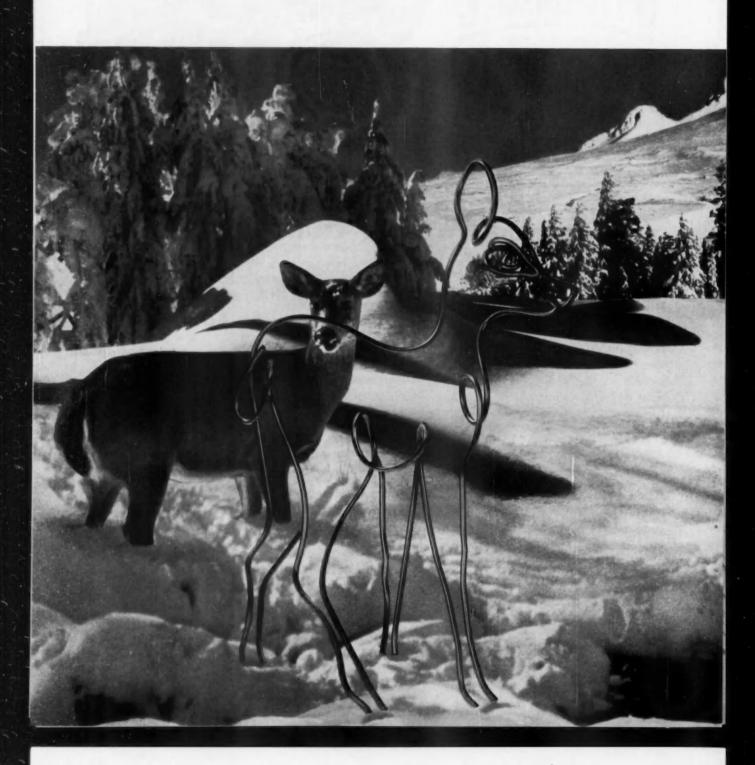
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AUTOMOTIVE INDUSTRIES, April 15, 1961

Circle 148 on Inquiry Card for more data

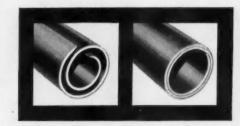
93

Bundy can mass-fabricate practically anything

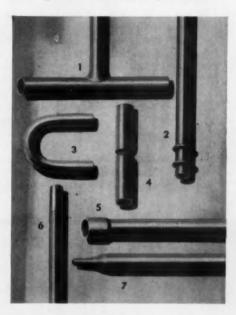


If you use tubing that requires fabricating—anything from simple bends to special forming and machining—it will pay you to talk to Bundy. Many of these mass-fabricating operations have been developed by Bundy especially for automotive use, and one of them may solve a difficult tubing problem for you. Your parts will be mass-fabricated from Bundyweld, the leakproof double-walled steel tubing. Bundyweld has long been the safety standard of the automotive industry and is covered by ASTM 254; and Govt. Specification MIL-T-3520, Type III. Can Bundy help you? Phone, write, or wire: Bundy Tubing Company, Detroit 14, Michigan.

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Bundyweld, double-walled from a single copper-plated steel strip, is metallurgically bonded through 360° of wall contact. It is lightweight and easily fabricated... has remarkably high bursting and fatigue strengths. Sizes available up to 5%" O. D.



Small-diameter tubing components massfabricated by Bundy may be the answer to your design problem. The Bundyweld tubing shown above is: (1) saddled and soldered, (2) double-beaded, (3) bent to minimum radius, (4) grooved, (5) expanded, (6) precision-ground, (7) swaged.



BUNDYWELD. TUBING

New Twin Coach

(Continued from page 73)

semblers, painters and welders were hired, together with two foremen having previous vehicle experience. Most of the new men hired were not skilled enough for Twin Coach's operation, so a highly concentrated training program was undertaken immediately to orient the new employees in the exacting techniques and procedures used by the company in its fabricating and assembly operations.

Although the first group hired numbered 63, the plant will ultimately employ around 300.

With power and water lines being laid down, machinery and equipment being assembled, and two truckloads of supplies from Buffalo arriving each week, production operations were started. The plant started out by fabricating all parts of the left rear fender, and the first release consisting of 200 pieces were spot welded and assembled by September 5. All other fabrications of the first release were completed

by September 25. The first complete unit was assembled on October 5 and packaged and shipped to American Motors on October 6, exactly 65 days after Twin Coach started operations in the Waverly plant.

The success of the venture is attributed to the close-working cooperation with Buffalo and the unique advance planning and control by the new plant planning committee. In Buffalo, a special assignment man was designated by Vice President Stuart Smith to work with Kaufman in testing new techniques and methods so that little production time in Waverly would be lost through trial and error. Purchasing and traffic control in Buffalo kept a constant, but not excessive, flew of materials and supplies to Waverly so that no shortages or supply and inventory problems developed.

Quantities, types of materials, supplies and equipment had previously been determined by the planning committee, but was constantly subjected to review and altered to fit local conditions as they developed. Small items such as light tools, bolts, files and torches when not immediately available, were purchased locally in the interests of saving time and developing good community relations.

Waverly kept in daily contact with Project Engineering in Buffalo so that problems were solved as they arose. At one point for example, self-locking mechanisms were found to be operating improperly. Design of the components was changed with design engineering's approval, via long distance telephone. On another occasion, two parts on the tail-gate of the "Mighty-Mite" were found to be out of tolerance when assembled. Engineering specifications were changed by Project Engineering, but because of these changes, serious tool problems cropped up and the new Division's ingenuity and resourcefulness were called upon. Tools usually sharpened by cutter grinder and other precision instruments, for example, were sometimes ground with a pedestal grinder by hand in a plastic block in order to maintain precision toler-



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all stamped with the T-MARK of total reliability

Other spring fasteners may look like Tinnerman Speed Nuts. But only those stamped with the T-mark really are Speed Nuts, made to Tinnerman's high, precise standards of reliability. Tinnerman quality controls are the most stringent in the industry. And only Tinnerman stocks a half-billion Speed Nuts... is tooled to turn out 10,000 variations... develops 25 new designs each week. Protect your product's good name by insisting on genuine Speed Nuts. Stamped with the Tinnerman "T"—the mark of total reliability. Tinnerman Products, Inc., Department 12, Box 6688, Cleveland 1, Ohio.

CANADA: Dominion Fasteners Ltd., Hamilton, Ontario. GREAT BRITAIN: Simmonds Aerocessories Ltd., Treforest, Wales. FRANCE: Simmonds S.A., 3 rue Salomon de Rothschild, Suresnes (Seine). GERMANY: Mecano Simmonds GMBH, Heidelberg.



ances. Contours on forming blocks were changed with the use of resin plastics. Punches were stepped and made shorter and shear angles installed in order to reduce the tonnage necessary in the stamping of parts. Adaptors were made to utilize power brake tools in the punch presses and punch press tools were adapted for the brakes in order to stabilize the work loads in both departments.

Production was threatened at one point because the plant had not yet received the equipment necessary to alodine aluminum prior to painting. At first parts were sent to Elmira for alodining, but this proved to be unsatisfactory. Plastic buckets were finally set up in the plant permitting alodining to be done in the plant.

Except for project, industrial and design engineering, the Waverly plant operates as a self-contained unit, performing all of the production, assembly and shipping functions locally. Utilizing the engi-

neering services of the home office in Buffalo, reduces the overhead of both the Waverly and Buffalo plants and in all probability this method of operation will continue for some time to come. The new plant will soon be able to produce anything from a needle to a tractor made of materials such as aluminum, steels, bronze or brass.

The Waverly plant is currently producing five "Mighty-Mites" per day, but is utilizing only 60 per cent of the available space. When all the production lines are set up, the Special Products Division will turn out 20 units a day. Currently. lines are being set up for M-101 3/4-ton Army trailer. When production hits its peak, 13 a day will be turned out. All of the Company's military contract production undergoes local Army Ordnance inspection. Waverly employees take great pride in the fact that even the very early units off the production line were given ordnance OK on the first inspection.

Cylinder Block Line

(Continued from page 65)

they are thoroughly cleaned, and chips are blown out of drilled or tapped holes. Main bearing caps are then placed on the bearing seats, and the screws torqued to 150 lb-ft.

A series of boring operations on a Natco three-way boring mill follows. The 31/2 in, pump bore in the front face is semi-finish bored and back counterbored; crankshaft, camshaft and starter bores are semi-finish bored, and miscellaneous dowel holes are semi-finish reamed and chamfered in front and rear faces. An auxiliary unit at an angle semi-finish bores for the injector pump. After these operations are completed, the block moves to a duplicate machine which completes the holes and bores semi-finished in the prior operation.

The thrust bearing is straddle faced and chamfered on both sides on a Natco special horizontal ma-





Harriet must be farce-ighted because, with present day, streamlined cars, you just can't see "what's going on down under." However, even though the mechanism is concealed, smooth performance is the "tip off" that Mather is on the job.

If you are concerned with specialized, scientific metal treatment, as applied to leaf springs, upset forgings, sway, hot formed and torsion bars, or if plastic extrusions seem perplexing, the chances are that Mather's over 50 years of experience in design, engineering and manufacturing can be helpful. Please call . . .





chine, using an expanding bar with tools to face both sides of the bearing. The cylinder head face is then finish milled on a Cincinnati special low bed vertical miller. Two Carlton radial drills with indexing fixtures are used to drill, ream, chamfer, and tap miscellaneous holes, the machining of which could not be incorporated in multiple spindle machines.

The cylinder bores are then finish bored and counterbored, and grooves are cut in them, using a Natco boring machine. Camshaft bores are honed on a Micromatic hone. The eight cam follower holes are rough gun bored on another Natco boring machine. The block then goes into a tank in a special test fixture that closes it to permit an air test for leaks. The cam follower holes are then gun reamed on a Natco machine to complete the machining of the cylinder block.

The finished casting is washed in a Magnus washer, blown out, and all burrs and wire edges are removed. In a second Magnus washer the block is rinsed and blown out, and the piece is then ready for conveying to the engine assembly floor.

All conveying in this line is done on roller conveyors, and most of the machines are loaded manually from the conveyor line, using turntables, lift sections, and the like. Rollover fixtures are used to rotate the block, but their use is minimized by planning carefully the sequence of operations.

The foregoing is Part II of a fourpart article by Kenneth Rose devoted to production at Deere's Waterloo Works.

Four-Cylinder Components

(Continued from page 59)

equivalent to the V-8 crankcases in the main bearing, cam bearing and oil gallery area with one bank of cylinder bores. For machining facility one locating and clamping lug at the front and rear of the crankcase replaces the second bank of cylinder bores.

In early operations these special lugs are used for location and clamping, as well as for transporting four cylinder crankcases from work station to station through the same fixtures of the transfer machines that are used for the V-8 crankcase. Without exception, both the four cylinder and eight cylinder crankcases are processed in a similar manner through every station of each machine.

By a system of sensing and switching devices, heads and units are actuated or held out as the case may dictate. There is a minimum of manual changeover from machine heads for four cylinder processing; but since some manual changeover is involved, it is advantageous to process the four cylinder and eight cylinder crankcases in separate batches. Also, batches of fours and V-8's are run consecutively because they have the same bore size and casting height. The three basic eight cylinder crankcases run over the same transfer line involve combinations of two sizes of cylinder bores and two casting heights.

In no case during the processing of the four cylinder and eight (Turn to page 106, please)



"tappets are our business"





PLANETARY AXLES

BEST DRIVE FOR THE HEAVYWEIGHTS!"

Here's new rugged dependability for prime movers, four-wheel tractors, heavy off-road wagons, mining and agricultural equipment, and many other heavyduty applications. Rockwell-Standard's complete line of planetary axles are available in capacities up to 150,000 pounds. And to meet every job need, there is a planetary steering axle operationally matched to each rigid planetary in the line.

The large reductions possible with Rockwell's full planetary, double-reduction axles enable them to ideally perform most heavy-duty off-highway operations. Because the substantial planetary reduction is located in the wheel hub, axle shafts and first reduction gears carry only nominal torsional loadsgive long trouble-free service. For the best heavyweight drive, specify Timken-Detroit.

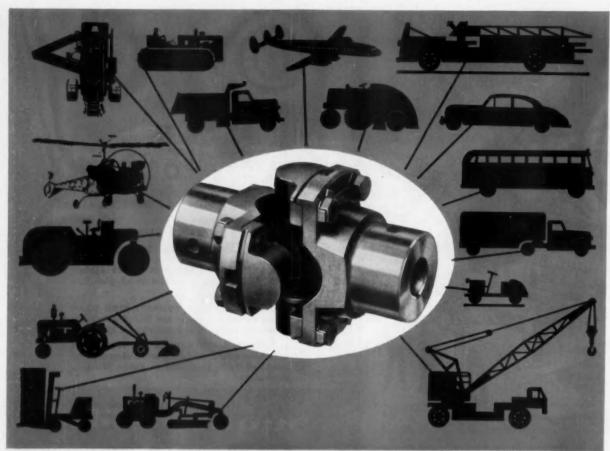
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VERSATILE MECHANICS Roller Bearing UNIVERSAL JOINTS have been used in almost every type moving vehicle everywhere—on the land—in the air—and in the water. They excel in their use for both main drives and controls—have transmission flanges for any type of brake drum—are easy to service—gives less down time—have

long slip—can run at greater angularity—and are of precision high quality. Let our engineers show you how the VERSATILITY of MECHANICS Roller Bearing UNIVERSAL JOINTS will give your products more competitive advantages.

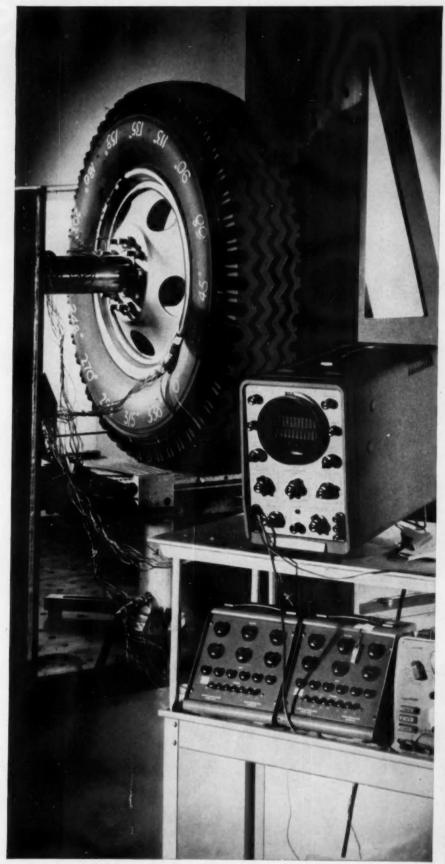
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 Busses and Industrial Equipment



proved industry's safest most dependable truck wheel

Kelsey-Hayes advanced three-piece wheel with tubular side ring and cold-drawn lock ring has no equal. Comparative stress analysis, destructive tests and millions of ton miles on the road prove it!



A basic reason for this superiority is great strength derived from highest property carbon steels, greatly enhanced by cold working in our highly specialized facilities ... the most modern in the industry. Kelsey-Hayes Company, General Offices: Detroit, Michigan.

KELSEY HAYES

COMPANY

World's largest producer of automotive wheels!

18 PLANTS: Detroit and Jackson, Michigan; Los Angeles; Philadelphia and McKeesport Pennsylvania; Springfield, Ohio; New Hartford and Utica, New York; Davenport, Iowa; Windsor, Ontario, Canada.



AUTOMOTIVE INDUSTRIES, April 15, 1961

Circle 157 on Inquiry Card for more data

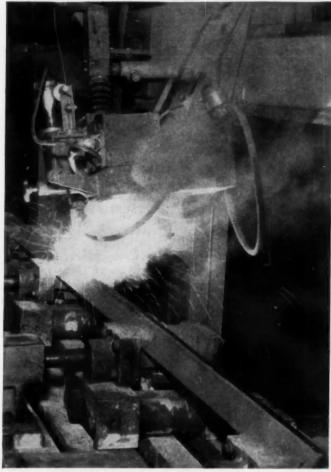
Leading automaker saves because ...

INNERSHIELD ELIMINATES

Two Innershield heads moving horizontally with two moving elliptically weld brackets to rear axle in $4\frac{1}{2}$ seconds. No separate flux or gas systems needed.

COSTLY FLUX HANDLING

Lincoln's new Innershield process is clean. No need for expensive flux handling and recovery systems. No abrasive dust to wear out costly, complex fixtures. Atmosphere stays cleaner, simplifies housekeeping, improves working conditions. No slag removal problems.



Innershield's special tubular electrode contains all ingredients for welding—fluxes, deoxidizers, filler metal. No Argon or CO₂ needed. Here, Innershield welds angle iron for farm machinery part at 80 ipm compared to 40 ipm with CO₂. Tanks, hoppers, structural beams all are now welded with this process, too.



Semi-automatic Innershield Squirt lets an amateur turn pro in minutes. Electrodes bridge gaps caused by poor fitup. Slag flicks off with a swipe of the electrode tip. Have a Lincoln field engineer show you how Innershield Squirt can increase the operating factor and deposition rates on your jobs.

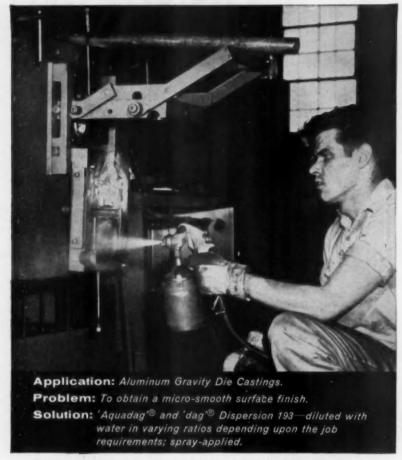


New brochure describing Innershield process and full and semi-automatic equipment is just off the press. Get your copy now. Write The Lincoln Electric Company, Dept. 1741, Cleveland 17, Ohio.



THE WORLD'S LARGEST MANUFACTURER OF ARC WELDING EQUIPMENT AND ELECTRODES

DIE CASTING REPORT



RESULT: SURFACE FINISHES ON ALUMINUM CASTINGS AS SMOOTH AS 40 to 60 MICROINCHES

Akron Gravity Die Casting Company, Akron, Ohio, has built a reputation on products with exceptional surface quality. These micro-smooth finishes . . . comparable to a tool room grind . . . have been insured by using Acheson's 'Aquadag' as a parting agent and 'dag' 193 as an insulating coating. By using the materials in these separate functions, Akron Gravity is able to achieve proper metal flow throughout the die cavity — eliminating deposit buildup, premature solidification, and metal-to-metal alloying. As a result they get both better casting surface finishes and longer die life.

The consistent uniformity, quality performance, and versatility of Acheson mold coatings for metal casting, are covered in Bulletin No. 425. Send for your copy, care of Dept. AI-41.

ACHESON - First name in solid lubricants for fifty-three years.



PORT HURON, MICHIGAN A division of Acheson Industries, Inc.

Sales offices in principal cities.

Also Acheson Industries (Europe) Ltd. and affiliates, London, England

Four-Cylinder Components

(Continued from page 100)

cylinder crankcases is there any extra handling of stock in order to bypass operations that are not applicable to the piece.

The two machining facility lugs remain on the four cylinder crankcase until all operations are performed and the crankcase is inspected and accepted for assembly. At that time the crankcase is processed through the only machine that has been added to the line for four cylinder production. It is a three station transfer type machine which drills and taps the engine mounting bracket holes, face mills fuel pump seat, drills, taps and chamfers valve tappet cover mounting holes as well as the fuel pump mounting holes, and finally saws off the machining facility lugs. Then the crankcase is ready for engine assembly.

Design Features

(Continued from page 63)

the excellent thermal conductivity characteristics of the aluminum.

Olds—The induction passages in the all-aluminum intake manifold are of the familiar "Double H" pattern, and have 1.02 sq in. of cross-sectional area to insure free breathing.

The high thermal conductivity of the aluminum made water warming of the intake passages practical.

Other advantages for the aluminum water-warmed manifold are increased fuel economy on short trip driving because the manifold stays warm for a longer period of time after the engine is turned off. Heat rejection to the cooling water is also reduced because an exhaust cross-over is not required in the cylinder heads and also because of the refrigeration effect of the gasoline in the intake passages.

Carburetors

Buick—A two barrel carburetor is standard equipment on both (*Turn to page 112, please*)



"We replace with LIPE CLUTCHES

for tough, city stop-and-go service"

T. R. Benjamen, President, Food Transport, Inc., a subsidiary of Lease Plan International Corp., has this to say:

"For the past nine years I have used Lipe Clutches as replacements in all of my thirty trucks. Many of them go 45,000 to 50,000 miles in city delivery service on my tractors alone . . . and in one instance, 125,000 miles on a straight truck."

Stop-and-go . . . creep-and-crawl . . . uphill-

downhill: Wherever terrain or traffic call for constant shifting, clutch maintenance costs are hard to keep in line.

Fleet owners from coast to coast have found the answer in Lipe DPB Clutches: More engagements between shop-stops. More total mileage. More miles per gallon of fuel. Lower cost per ton-mile.

Naturally, with results like these, one Lipe user tells another. And that's why . . .

the trend is to LIPE!



*There is a Lipe Clutch to meet requirements of vehicles 18,000 lbs. G.V.W. and up; for torque capacities from 200 to 3000 ft. lbs. For application assistance and specific data, contact the Company direct.



DOT。 NYLON PUSH-IN NUT

- Non-corroding
- Electrical insulator
- High pull-out resistance
- Straight legs won't distort thin, soft materials

This versatile fastening device snaps into place under finger pressure alone. Its straight legs permit easy insertion in square, punched holes while the tapered screw hole forces the legs apart when screw is inserted and ensures maximum pull-out resistance. Burrs do not impede the nut or prevent proper seating.

Ideal for use in virtually any type of thin-walled structure of sheet metal or plastic, the DOT Push-in Nut does not chip enamel surfaces, locks tightly without distorting the edges of the hole, resists vibration and serves as an excellent electrical and thermal insulator.

Suitable for use with #8 or #10 screws...locks in holes from .275" to .292" square... application thickness range: .030" to .060". Spacer type available with $\frac{1}{2}$ " dia. head from $\frac{1}{6}$ " to $1\frac{3}{2}$ " length in increments of $\frac{1}{3}$ ". Other types available in various sizes, round or square-headed, from $\frac{1}{3}$ " to $\frac{1}{8}$ " thick.

Engineering details and price information available on request.

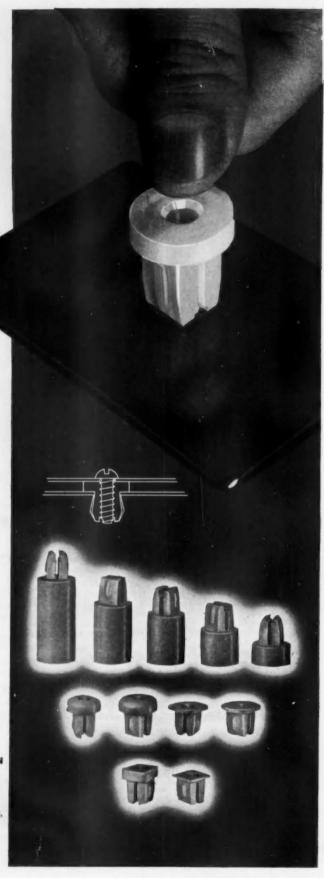
CARR FASTENER COMPANY

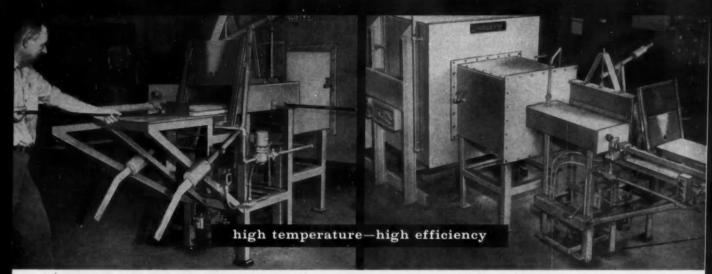
Division of UNITED-CARR FASTENER CORPORATION

Cambridge 42, Mass.



Offices in: Atlanta, Boston, Chicago, Cleveland, Dallas, Detroit, Kalamazoo, Los Angeles, Louisville, New York, Philadelphia, San Francisco, Seattle, Syracuse





This new Lindberg Molybdenum Element Pusher Type Atmosphere Furnace has a maximum temperature of 3000°F, with 60KW input. It embodies high temperature refractories suitable for low dew point without muffle and is ideal for sintering stainless steel compacts in hydrogen or dissociated ammonia. Furnace provides side loading and discharge ports with purging chambers. Installation at right also shows conveniently located ammonia dissociator and control panels.

If your production processes require sintering you can depend on getting exactly the right equipment for your needs from Lindberg's comprehensive line of dependable, efficient, production-proven furnaces





Lindberg Roller Hearth Continuous Type Furnace handles loads up to 2200 lbs. per hour in temperature range 1300°F. to 2100°F., for bright annealing, silver brazing and sintering metal powder.



Lindberg Hand Pusher Batch Type Furnace has a temperature range of 1300°F. to 2500°F. Also sintering capacities from 25 to 300 lbs. per hour available.

For full information on the furnaces illustrated and Lindberg's complete line of sintering and brazing furnaces, just get in touch with your local Lindberg Field Representative (see classified phone book) or write direct. Please remember, too, that Lindberg offers a variety of Atmosphere Generators to provide, efficiently and economically, the proper atmospheres recommended for use with our sintering furnaces. Heat Treating Furnace Division, Lindberg Engineering Company, 2491 West Hubbard Street, Chicago 12, Illinois.

Los Angeles plant: 11937 S. Regentview Avenue, Downey, California. In Canada: Birlefco-Lindberg Ltd., Toronto.

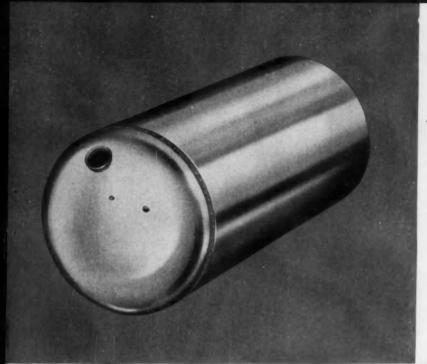
LINDBERG-

heat for industry



REPUBLIC A-286

In addition to excellent corrosion resistance, this precipitation hardenable grade is designed to afford elevated temperature creep and stress rupture strength to over 1200°F. Because it is used on critical applications, majority of tonnage produced is processed from ingots that have been vacuum melted by Republic's consumable electrode process. Typical applications; jet engine and gas turbine components such as wheels, blades, frames, housings, afterburners, tail cone parts, and fasteners.



REPUBLIC 17-7 PH" and PH 15-7 Mo"

These steels possess the cold formability of austenitic stainless grades... the hardenability of martensitic grades. High strength levels and good creep resistance are maintained at temperatures to over 700°F. and 900°F. respectively. Typical applications: aircraft and advanced missile structural parts, bellows, hose clamps, leaf springs and spring clips, pressure tanks, surgical instruments, antennae.

REPUBLIC 17-4 PH*

Simple heat treatment after fabrication develops high strength levels without excessive distortion or scaling. Unlike most martensitic chromium types, Republic 17-4 PH* is welded without preheating or post annealing, thus resulting in lower fabricating costs. Typical applications: bearings, bolts, shafts, aircraft fittings, gears, splines, mandrels, pins, seats, and valves.

BECAUSE THEY OFFER GREATER VERSATILITY, precipitation hardenable stainless steels broaden the already wide field of stainless steel applicability. Better properties at elevated temperatures are coupled with the formability and corrosion resistance of other stainless grades. Republic PH Stainless Steels are available in the standard mill products. Mail coupon for data.



REPUBLIC STEEL

Cleveland 1, Ohio

REPUBLIC HAS THE FEEL FOR MODERN STEEL



Strong, Modern, Dependable

*Licensed under Pat. Nos. 2482096, 2505763 and Trade Mark of Licensor.

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REPUBLIC STEEL CORPORATION DEPT.AI - 2043 1441 REPUBLIC BUILDING - CLEVELAND 1, OHIO

Please send more information on:

☐ Republic 17-4 PH

Republic 17-7 PH and PH 15-7 Mo

Republic A-286

Name_____Title__

Name_____ ine____

Address

City Zone State



Design Features

(Continued from page 106)

Synchromesh and automatic transmission engines and incorporates an aluminum throttle body which, in conjunction with a metal carburetor to manifold gasket, provides excellent heat transfer characteristics. This construction reduces appreciably the tendency of the throttle valves and idle system to "ice up" under adverse atmospheric conditions.

Olds—The standard "Rockettee" engine has a Rochester Products two-jet carburetor. The venturi are one inch in diameter and the throttle bores are 1-5/16 in.

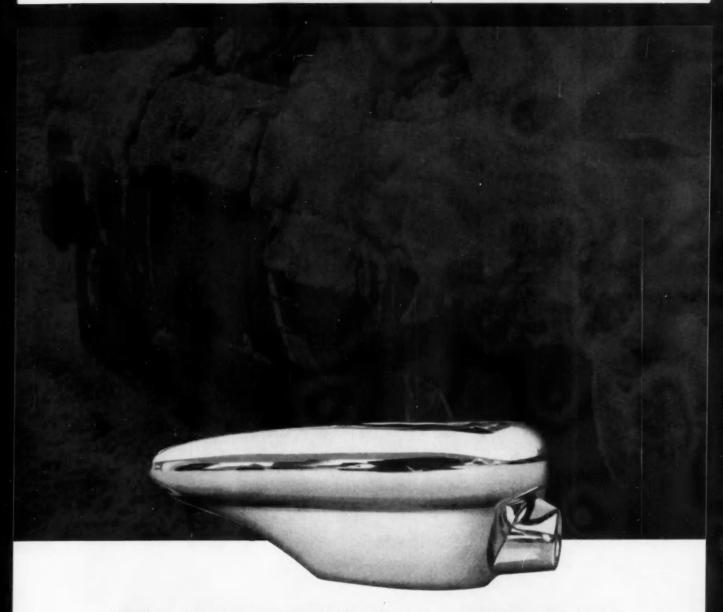
The standard "Rockette" is equipped with a carburetor cover which serves as the top cover for the air cleaner containing the air inlet snorkel (Fig. 7). This new design, developed at Oldsmobile, keeps dirt and road splash off the carburetor, cools the carburetor bowl better by circulating the intake air around the carburetor before delivery to the engine, and provides a larger chamber for intake air silencing.

Fuel Pumps

Buick—The fuel pump is mounted low on the left side of the front cover and driven by a sintered iron eccentric mounted on the camshaft. A glass oowl, paper cartridge fuel filter is standard on all engines and is mounted near the carburetor to prevent foreign material from entering the critical needle seat or jet areas.

Olds—A mechanically-operated diaphragm type fuel pump is located on the engine front cover. Between the fuel pump and carburetor is a fuel filter and sediment bowl. This filter also serves as a fuel vapor diverter which returns fuel vapors to the fuel tank in a separate line to eliminate vapor block.

Part II of this two-part article will be devoted to cylinder blocks, pistons, connecting rods, crankshafts, and exhaust manifolds of the Buick Special and the Olds-F-85 aluminum engines. It will appear in an early issue of AUTOMOTIVE INDUSTRIES.



The thicker the M&T chromium plate the longer it lasts in service

How much thicker you want to plate chromium depends on the part, the type of deposit, and its end use. But thicker it should be. You definitely improve corrosion resistance of steel parts and zinc die castings as you increase chromium thickness.

By plating with M&T's MICRO-CRACK CHROMIUM, either in a single or duplex deposit, you outperform ordinary chromium plate not only on speed of deposition, but also on quality. A thickness of about 50 millionths of an inch over nickel gives much better protection. The finish resists blemishes far longer.

Two SRHS[®] (self-regulating, high speed) Baths are used to produce the *Duplex* chromium plate. The first one gives better coverage of recessed areas, and

more uniform plate thickness overall. This is followed by the second deposit of M&T MICRO-CRACK CHROMIUM for a combined thickness of about 50 millionths. Even in the recesses, this combination dramatically increases resistance to weather, outdoor atmospheres, snow melting chemicals.

Whichever plate you choose for current or 1962 production, there's not only greater customer satisfaction but also more profitable operations in store for you. Each speedy bath cuts plating time for thicker chromium. Each self-regulates important ingredients for optimum plating efficiency, easiest control, best results. Send for technical data or for an M&T Plating Engineer to tell you more.



plating products · welding products
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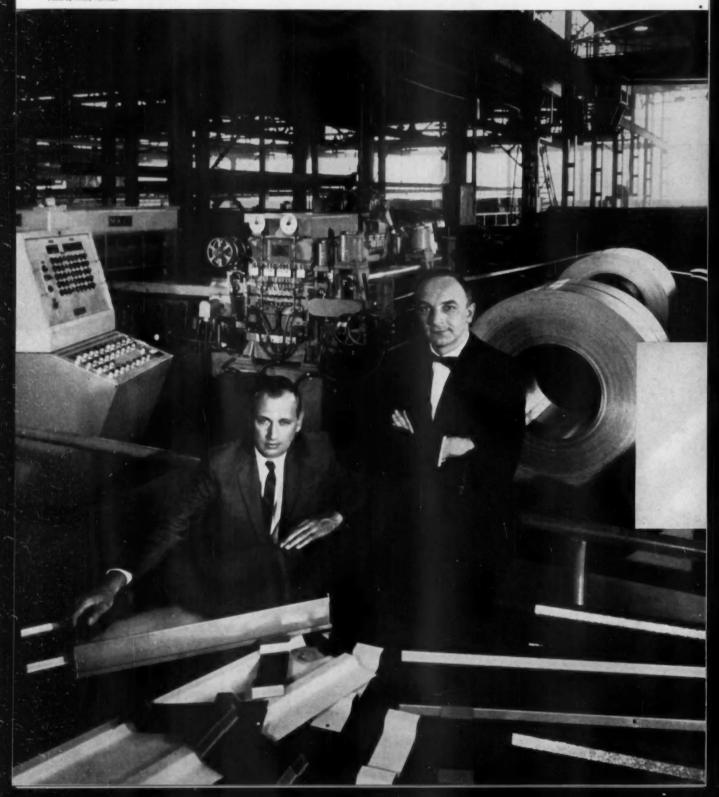
METAL & THERMIT CORPORATION, General Offices: Rahway, New Jersey In Canada: M & T Products of Canada Ltd., Rexdale, Ontario

McKAY DIE SHEAR LINES CUT MORE THAN

STEEL. The most economical and efficient shear lines in operation today, they are being used by dozens of leading metal producers, fabricators and warehouses to alsah shearing costs. Here, McKay Sales Manager Joseph F. Lyden, Jr., and M. G. Slaney, Building Division Manager, The Parkersburg (W. Va.) Rig and Reel Company—one of the nation's fastest growing manufacturers of pre-engineered metal buildings—examine panel sections cut to length by the high speed McKay Die Shear Line in the background.

This is McKay

Photo by Arnold Newman



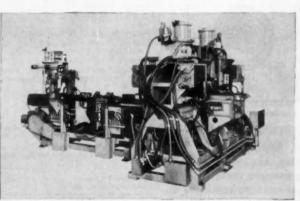
Machine....

a recognized leader in the development and manufacture of high production metal processing equipment!

If you fabricate metals and are caught in the "profit squeeze" you'll want to know more about McKay Machine.

It was McKay Machine that pioneered automated integrated production lines, and it is McKay Machine that is today a leader in this field. We have conceived and produced complete lines for the manufacture of building panels, aircraft and missile sections, appliances, cabinets and components, automotive bodies and parts, and farm equipment—lines that are completely automated from raw material to finished part or product.

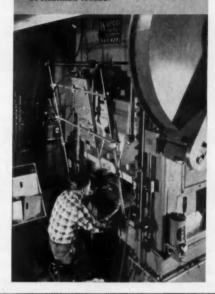
Whatever you make, if it requires metal handling, feeding, slitting, shearing, stamping, welding or forming, it's just good business to acquaint yourself with McKay Packaged Production Lines—high speed production equipment engineered to work in unison—with one-source responsibility from start to finish. Write for literature to The McKay Machine Company, Youngstown 1, Ohio.

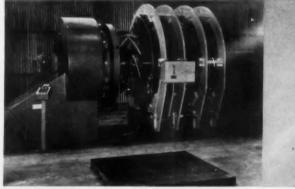


FEDERAL RESISTANCE WELDERS AND WELDING LINES, like this multi-gun combination spot and projection welder used by Hotpoint on their range production line, can be found in the plants of leading metalworking firms the nation over. Individual units, or complete resistance welding lines, are engineered to specifications by McKay's Federal-Warco Division.

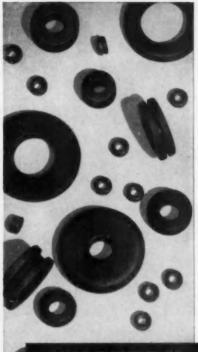


warco mechanical presses—advanced in design, noted for their craftemanship—are used throughout industry. Typical is the high speed, low maintenance 150-ton straight side crank press pictured here in operation at Eastman Kodak.





BERKELEY-DAVIS AUTOMATIC ARC WELDING MACHINERY produced by Berkeley-Davis, Inc., a subsidiary, is highly popular in the aircraft, rocket, automotive and appliance industries. The rocket body welder pictured here is working at Aerojet General, subsidiary of General Tire and Rubber Company.





GROMMETS

... by the Millions

Grommets for any conceivable industrial purpose from natural, all purpose (GR-S), Neoprene and Buna-N rubbers.

Western grommets come in hundreds of standard sizes, and can be ordered in any formulation from molds already prepared.

Western Rubber is fully equipped for production of either standard or custom designed grommets in any size, shape or volume. All are quality controlled and economically produced to your specifications.

Write or phone for information or a visit by our sales engineer in your area.



ESTERN

RUBBER INDIANA

MOLDED AND LATHE-CUT RUBBER PARTS FOR ALL INDUSTRIES

"PRECISE POWER" BY CONTINENTAL MORE POWER TO YOU IN TRANSPORTATION



"More Power to You" is more than a mere slogan. It is a four-word summary of Continental's stock in trade. And actually, it tells only part of the story, for Continental provides not only MORE but BETTER power -power that is engineered precisely to its job. The unmatched breadth and diversification of the Continental line assures precise Red Seal power for heavy-duty highway trucks and tractors, both as original equipment and as replacements for other makes, in buses, taxicabs, door-todoor delivery vehicles, transport mixers and the like.



FORTY-FIVE TRANSPORTATION **ENGINES ARE AVAILABLE:** GASOLINE-DIESEL-LPG-WITH BASIC MODELS RANGING FROM 26 to 300 HORSEPOWER

Continental Motors <u>Corporation</u> MUSKEGON, MICHIGAN

MORE GOVERNMENT CONTRACT AWARDS

TATEST contracts awarded by vari-Jous Government agencies, and covering primarily automotive and aviation products, are listed in the following. Typical of the items contained in these monthly listings are: passenger cars, motor trucks, aircraft, military tanks, engines, transmissions, other components, spare parts, plant equipment, etc. This list is for the period Feb. 28 to Mar. 30 inclusive.

AMBRUSTER & CO., INC., Fort Smith, Ark. Trucks, 3 ea.—\$19,917

ARCWELD SALES CO., Grove City, Pa. Testing Machines & Vacuum Furnaces -\$80,539

CHRYSLER MOTORS CORP., Wash-ington, D. C. Motor vehicles, various, 7 ea.—\$27,305 Crane, truck—\$88,830

CLARK EQUIPMENT CO., INDUSTRIAL TRUCK DIV., Battle Creek, Mich. Truck, lift, fork, 75 ea.—\$663,265 W. S. DARLEY & CO., Washington,

W. S. DARLEY & CO., W. D. C.
Motor vehicles, 2 ea.—\$25,299

H. ELLIOTT CO., Washington, D. C. Boring, milling & drilling machine, 1 ea.—\$76,326

FORD MOTOR CO., Washington, D. C. Motor vehicles, 19 ea.—\$68,121
FORD MOTOR CO., GOV. SALES DEPT., Washington, D. C. Dump trucks, 6 ea.—\$15,722 SALES

FORD MOTOR CO., FORD DIV., Wash. ington, D. C. Trucks, various, 27 ea.—\$70,622

GENERAL MOTORS CORP., MOTOR DIV., Detroit, Mich. Trucks, various, 92 ea.—\$213,045 CHEV.

GENERAL MOTORS CORP., Detroit. Mich. otor vehicles, 26 ea.—\$86,798 Motor

GENERAL MOTORS CORP., CHEV. MOTOR DIV., Detroit, Mich. Sedans, 5 ea.—\$9,505

GENERAL MOTORS CORP., FO DISTRIBUTORS DIV., New N. Y. Trucks, various, 11 ea.—\$20,936 FOREIGN

GROVE MANUFACTURING CO., Washington, D. C.
Crane, truck—\$88,830

Crane, truck—\$00,000

INTERNATIONAL HARVESTER CO., Washington, D. C.
Cab & chassis, 1 ea.—\$10,145

INTERNATIONAL HARVESTER CO., Washington, D. C.
Motor vehicles, 5 ea.—\$33,062

INTERNATIONAL HARVESTER Washington, D. C. Trucks, various, 23 ea.—\$133,065

R. K. LEBLOND MACHINE TOOL CO., Cincinnati, Ohio Lathe, engine, 6 es.—\$78,122

BILENT HOIST AND CRANE CO., Brooklyn, N. Y. Crane, truck—\$93,285 STUDEBAKER - PACKARD CORP., South Bend, Ind. Trucks, 13 ea.—\$25,175

Trucks, 13 ea.—\$25,175

UNITED TRACTOR & MATL. HDLG.
EQUIP. CO., DIV. OF UNITED
BOILER HTG. & FDRY. CO., Hammond, Ind.
Tractor, wheeled, 24 ea.—\$78,362

GEORGE E. VIERECK & CO., Washington, D. C.
Milling machine, portable, 2 ea.—
\$67,303

WALTER MOTOR TRUCK CO., Voorheesville, N. Y. Motor vehicles, 2 ea.—\$27,800 WILLYS MOTORS, INC., Toledo, Ohio Trucks, 63 ea.—\$158,743

Fractional Horsepower Motors



Lamb Thinking on Universal Motors for a unique actuator application

Here's what Lamb Electric designed into these motors:

In order to obtain the required speed and torques and retain the most economical and smallest package, a combination worm and spur gear reduction was used. Also, because of the peculiar space limitations in the application, special design considerations had to be given to the gear ratios and mechanical layout of the package.

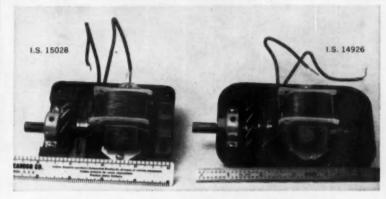
In the initial stages of the design a motor was provided which met the specified speed and torque requirements, however it was soon discovered that this design overheated rapidly. Analysis of the first prototype tests showed that the load cycle had a particularly high torque peak for a very short duration. The motor was designed to supply this amount of torque near its stalled speed. It was found that by taking advantage of the accelerating rate and starting torque of a universal motor, the motor accelerated quickly enough to provide sufficient inertial energy to complete the duty cycle. This enabled the engineers to redesign for a lower peak horsepower output and obtain reasonable operating temperatures, thus producing the minimum size package consistent with the torque and temperature requirements.

The application was such that severe shock loading was encountered at a certain point in the duty cycle. In order to make mechanical construction that would withstand this service, ductile iron castings were furnished and special consideration had to be given to the overhung moment of the motor-gear unit to insure against damage due to vibration. Special bearings had to be used in this service because Brinnelling would occur on normal ball bearings under the severe service encountered. Lubrication is generally a problem under this short duty cycle, therefore, special consideration had to be given to insure that the lubricant protected the wearing surfaces at all times.

This is just a short example of Lamb at work . . . if you have a motor problem, let us help you with it. This is our business. Write: Lamb Electric, Kent. Ohio, and we'll have a Lamb District Engineer call on you to open preliminary discussion of your problem.



THE LATEST DESIGN NEWS ON FHP MOTORS FROM LAMB ELECTRIC



New Lamb motors represent advancements in small universal motor design

New design combines high quality and long life with relatively low manufacturing costs

Initially, the I.S. 15028 and companion motor I.S. 14926 were designed for powering rug agitators on a well-known line of canister-type vacuum cleaners. Now, many future appliance applications have been visualized. The range of ratings possible with this design (as high as 1/10 H.P. at 12000 RPM or ½ H.P. at 15000 RPM) makes this motor ideally suited for many motor powered domestic applications.

Some of the novel features of this motor project were:

The housing is a one-piece simple phenolic molding. It is designed in a half shell form in such a way that the motor bearings and other components can be held in accurate relationship with an unmachined housing.

The half shell housing of the motor is designed to mate with a corresponding opening on the customer's device to complete the motor enclosure. When a free standing motor is desired, this

upper enclosure can be a simple stamping.

The I.S. 15028 motor was designed with a sleeve and a ball bearing. However, on other versions of this motor, either sleeve or ball bearings or a combination can be used at only a low tooling expense through use of easily interchanged inserts in the housing mold cavity.

The sleeve bearing as used in this design takes full advantage of the economics possible with the half shell motor design. The full-spherical shaped self-aligning type of sintered bearing is mounted directly in a semi-spherical recess in the housing. A spring clip presses against the top of the bearing to secure it in place while at the same time permitting self-alignment movement. Life-time lubrication is provided by an oil soaked felt strip located beneath the bearing. There are other features worth noting in this unique design problem. For further particulars, write to Lamb Electric Co., Kent, Ohio.



Stainless by

CRUCIBLE

where a fine finish is only the beginning

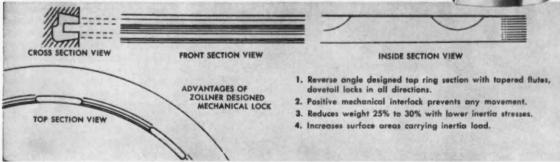
#1 Piston choice of BOND E LOC Diesel Engine Builders KEEPS ENGINES POWERFUL LONGER-AT LOWER COST

Exclusively DOUBLE BONDED "Ni-Resist" IRON TOP RING SECTION METALLURGICALLY

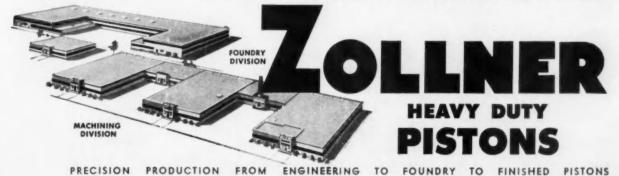
Stops Ring Groove Wear

Everywhere, engine builders and transport operators enthuse over the performance of Zollner Bond-O-Loc Pistons - "The greatest mileage piston we have ever used. Top ring groove wear problems are eliminated by the 'Ni-Resist' Iron section permanently incorporated with the double bond of both A1-Fin metallurgic and the exclusive Zollner mechanical lock." For longer piston life, better performance and lower maintenance cost, we suggest your immediate test of Bond-O-Loc advantages.





ZOLLNER CORPORATION . FORT WAYNE, INDIANA



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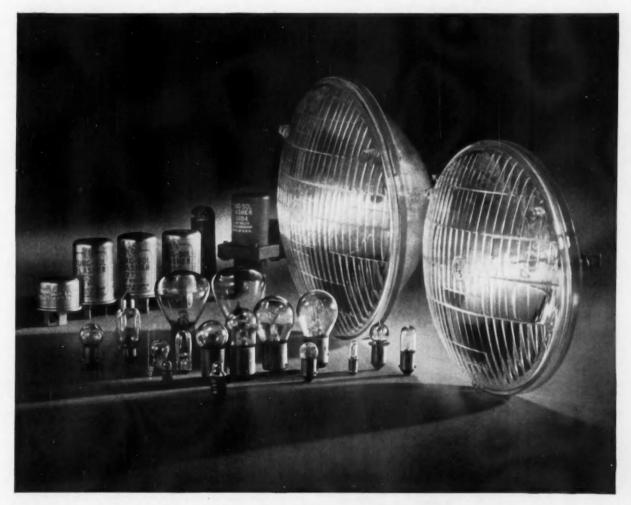
Congress is planning an ambitious program of investigating the ills of small business. In the Senate, 28 major problems will be explored in the months ahead. There will be lots of talk, some help. Major areas to be studied include tax problems; tax depreciation allowances on capital equipment; impact of mergers; refusal to deal and right to buy, and dual distribution by manufacturers who own their own stores.

An accelerated government program to bring U. S. industrial equipment up to date may be started in the fear that the Nation's machine tools are too outdated to fight any kind of war. Defense mobilization experts say that more than 60 per cent of U. S. machine tools are too obsolete to keep industrial production going in either a limited or an all-out war.

Federal, state and local governments have begun a coordinated movement to funnel more government contracts into areas of chronic unemployment. Pennsylvania is the first state to try the new program. Pennsylvania will list the names of local firms in labor surplus areas with the type of contract on which they could compete. The lists will be distributed to c o n t r a c t-letting government agencies and to prime government contractors.

An antitrust steamroller is beginning to roll out of Washington. It will steam its way through industry throughout the country. The steamroller is a coordinated antitrust effort by the White House, Justice Dept., Federal Trade Commission, and Congressional investigators. The latest evidence of coordination is a Justice Dept. and FTC pact to learn if defendants in 56 past antitrust cases are living up to the judgments against them.

Tung-Sol has achieved remarkable results in meeting the ever higher quality demands of the automobile industry while lowering the cost of Tung-Sol products



INTUNG-SOL®

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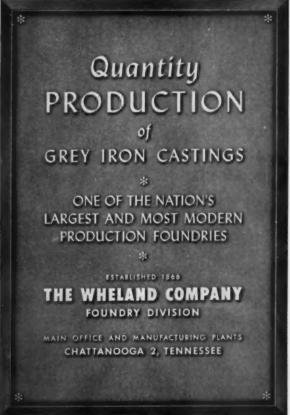




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Firestone Buys Dayco

Firestone Tire & Rubber Co. has reached an agreement to to purchase the Dayco Corp. tire division in Dayton, O. The sale awaits approval of the boards of directors. Firestone will purchase the assets of the tire maker including manufacturing facilities, equipment, furnishings and inventory.

Record Spending

B. F. Goodrich Co. plans record outlays for 1961 and expects its second half earnings to exceed the same 1960 period, John N. Hart, comptroller, told the Boston Society of Security Analysts. He said capital expenditures will total \$55 million against \$41.3 million

in 1960 and \$45 million in the record year, which was 1954.

Gardner-Denver Mark

Record sales of \$84.7 million for 1960 have been reported by Gardner-Denver Co. This was an increase of six per cent over the \$79.7 million sales in 1959. Net earnings last year were \$7.1 million, a 16 per cent decrease from \$8.4 million in 1959. Earnings in 1960 were \$3.12 a share compared with \$3.75 in 1959.

Fansteel Buys Wesson

Fansteel Metallurgical Corp. has contracted to acquire Wesson Tool Co., Detroit. Wesson firms include Wesson Multicut Corp., Wesson Metal Corp., including the Archer & Smith Div., and the Wesson Co. Fansteel also is acquiring the controlling stock interest in the Canadian subsidiary, Wesson Cutting Tools, Ltd.



VICTOLEX is a new multipurpose sheet packing developed from a blend of cellulose fiber and synthetic rubber. In toughness, strength and resiliency, it beats ordinary glue-glycerin treated paper packing. Victolex has good dimensional stability - won't shrink, stretch, dry out or break down under pressure or heat-and has excellent

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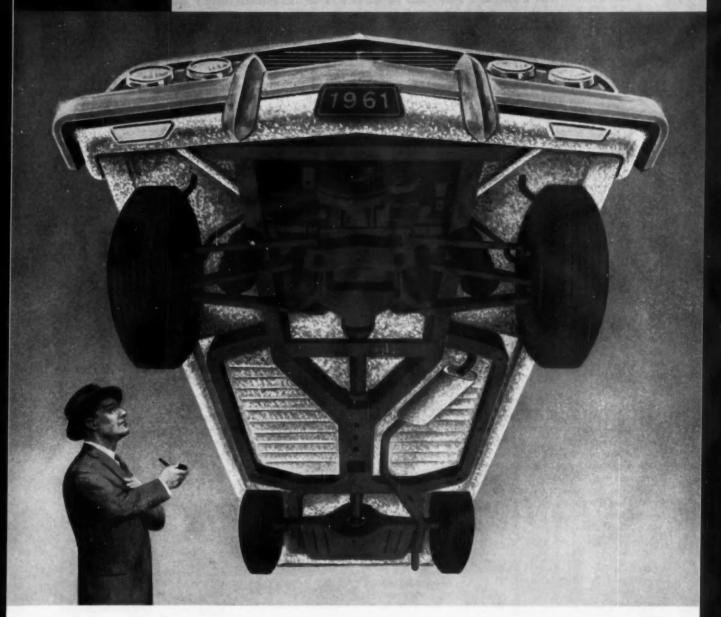
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Does your car have the protection of galvanized steel?

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Many new cars coming off the assembly line now feature underbodies made of tough, corrosion-resisting galvanized steel. sofTrte® Galvanized Steel, originated by Wheeling Steel, is ideal for this use. sofTrte's galvanized coating doesn't flake or peel. It's tough, dependable, long-lasting — under all types of corrosive conditions. That's why our challenge stands: Anything that can be made of steel sheets can be made of Wheeling SOFTITE Galvanized Steel Sheets.

Wheeling is proud to be supplying the automotive industry with both sofTite galvanized and regular sheet steels. We salute the industry's never-

ending drive to give the world the greatest possible automotive values. Wheeling Steel Corporation, Wheeling, West Virginia.

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By C. J. Kelly ASSISTANT EDITOR

Control Valves

New CM11 series multiple unit valves for use on hydraulically operated mobile equipment are described in bulletin M-5112, 8 pages. This bulletin includes numerous photographs highlighting design features, sketches, showing basic spool designs, and several charts which provide pressure drop information. Vickers, Inc.

Maintenance

A new 16-page picture booklet, presenting helpful facts about making maintenance and repair parts, has been made available. The booklet, entitled "One Way to Make Your Job A Little Easier," will be of particular interest to maintenance executives, engineers and other key maintenance personnel. It will also prove helpful to designers, production and research men who must make any kind of special machinery or equipment requiring machine parts. LaSalle Steel Co.

Grinding Wheels

New catalog bulletins about purpose grinding wheels and plain cylindrical grinding wheels have been issued. Bulletin ESA-141 about general purpose offhand grinding includes recommended grain and grade specifications and reference to Red Center plastic reducing bushings. Bulletin ESA-191 about plain cylindrical grinding includes reference to the faster operating speeds coming into use under certain conditions. It also includes grain and grade recommendations for grinding various materials. Simonds Abrasive Co.

Laminated Plastics

Basic application information and engineering data on laminated plastics and Tayloron vulcanized fibre is given in a condensed catalog. The data in the eight-page catalog is provided to aid engineers in selecting and applying these basic materials for electrical, electronic and mechanical components. The first two pages of text describe laminated plastics and vulcanized fibre in general terms, telling how they are made and where they can be used. The page on laminated plastics points out that more than 50 grades are available to meet any requirement. Taylor Fibre Co.

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A completely revised edition of "Barrel Finishing" has been published. Contents of this 96-page booklet include descriptions of the various barrel finishing processes, recommendations of the various abrasive shapes and sizes for applications in which they are best suited, case histories of actual uses, description of all types of finishing equipment available, discussion on compounds and their effects, and a section devoted to practical suggestions on operating procedures. Norton Co.

Stock Bearings

A stock Bearings catalog lists the complete line of standard size cylindrical and standard flange bearings made in Arguto-MP material. These standard Arguto-MP Bearings include all ASTM specifications. Tables of dimensional Tolerances are also included in the new catalog as well as recommended press fits, running clearances, machining and other technical information. Arguto Oilless Bearing Co.

Specifications

A new 54-page catalog listing official United States Government Specifications for a wide variety of adhesives, coatings and sealers is now available. The catalog lists, in numerical form, military specifications, specification definitions, intended application and the corresponding 3M adhesive, coating or sealer that meets these specifications. Minnesota Mining & Manufacturing Co.

Saws and Tools

A book combines the utility of a catalog and the function of a reference handbook. This new book lists a complete line of carbide tipped blades and tools. All of the standard blades are listed. A big feature is the Blade Selector which shows what blade to use for every type of material and cutting condition. The Nomenclature names all parts of the blades so that confusion is eliminated - you know how to identify a "right" and "left" hand blade-how to protect Carbide Tipped Tools and Blades in production. Victory Carbide Saw and Tool Co., Inc.

standard height UNC and UNF hex type Elastic Stop nuts. It discusses factors to be considered in selecting a tightening torque: also the effects of the use of lubricants. Additional data includes tables of tensile stress areas and tables of bolt strengths. Elastic Stop Nut

Rubber Booklet

10

A 12-page booklet, "Versatility in Rubber" tells of the need for manufacturers to analyze the rubber components used in their products on a continuing basis. The factual information and illustrations used throughout this booklet provide a clear picture of the thorough problem solving techniques used to develop rubber parts which economically enhance and improve product performance. Roth Rubber Co.

Precision Metalworking Equipment

A new 32-page complete line catalog gives detailed information and costs on all Di-Acro precision metalworking equipment. Called Catalog 61 it shows all hand and power operated Di-Acro Precision Metalworking Machines. Additional pages list related accessories and expendables. The new catalog begins with a selector guide and index which provides a means of quick references. Di-Acro Corp.

Arc Welding

Information concerning a full line of arc welding products is contained in bulletin 7000.7, entitled "Weldirectory of Arc Welding Electrodes, Equipment, and Supplies." This bulletin presents information on AWS electrode classification and discusses correct electrode selection for every type of welding application. Arc characteristics, welding procedures, and physical properties are listed for each electrode including stainless steel, cast iron, and hardsurfacing types, as well as those designed for mild and low alloy, high tensile steel welding. Lincoln Electric Co.

Precision Switches

A new 20-page catalog, covers a representative selection of products from a complete line of precision switches for industrial, commercial, data processing, airborne and electronic applications. Designated catalog 104, it has photos and condensed descriptions of over 200 items, including miniature switches, special purpose switches, electronic switch - circuit assemblies, lighted pushbutton switches, toggle switches, limit switches, proximity switches and mercury switches. Micro Switch, a Division of Minneapolis-Honeywell Regulator Co.

Mach II Aircraft 14

Bulletin GER-1704, 16 pages, describes an integrated ac electrical system aboard nation's newest all-weather Mach II aircraft, F4H. Included is a discussion of system components: hydraulic constant speed drives, fine frequency and parallel control unit, ac generator and protective panel, static exciter-regulator, as well as an explanation of the system's operation. Schematic diagrams, technical drawings and photographs of the equipment are also shown. General Electric Co.

Rulon and Teflon

A concise yet comprehensive 4page brochure describes the characteristics and qualities of Rulon and Teflon. Of special interest to product design engineers, brochure 9572 compares the electrical, physical, mechanical and chemical properties of these materials. Dixon Corp.

Air Filter 16

A product bulletin describes the new high efficiency dry-type unit air filter. Bulletin 228 illustrates and explains the revolutionary new light-weight filter which answers the demand for a unit filter of high efficiency, low resistance, compactness and unusual dust holding capacity. The new bulletin describes its uses, construction, installation, operation and holding frame arrangements. Also included are dimensional drawings, performance data, space requirements and suggested specifications. American Air Filter Co., Inc.

Milling Spindles

Operating data and specifications of a full line of constanthorsepower infinitely - variable speed standard milling spindles is available in bulletin CMS-61. Available in an almost unlimited combination of ratings and speeds up to 50 hp, the line covers 4 basic series, each with 4 basic models. Dimensions of importance in adapting these spindles on existing machine tools are included. Colonial Broach & Machine Co.

Heat Treat Bulletin

This new six-page, gatefold bulletin is fully illustrated and covers the application of vertical and horizontal equipment for processing continuous strip. Heat treatments discussed are for ferrous and also non-ferrous strip metals, and involve annealing, normalizing and galvanizing processes. Surface Combustion Div., Midland - Ross

Motodrive Catalog

Catalog G-100, new 88 page publication covers complete line of Reeves Vari-Speed Motodrives, % through 40 hp. Data in the catalog includes full rating tables, with new additional output speeds. Dimension diagrams and charts for over 100 different assemblies, new higher overhung load and new controls, are also contained in this new catalog. Reliance Electric and Engineering Co.

Gas Equipment

Applications of commercial gases to commercial processes are thoroughly described in a completely new 16-page profusely illustrated brochure. The new brochure shows the Furkert Gas/Airmixer for accurately premixing gas/air mixtures of any commercial gas; manufactured, natural, mixed, propane or butane. Gas Appliance Service, Inc.

Trolley Conveyors

What a trolley conveyor can do to reduce manufacturing and handling costs-and how to select the right trolley conveyor for any equipment-these are the two main topics of a new 58-page book, 2730, called "Trolley Conveyors." Link-Belt Co.

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Back-Up Rings

Claimed the first really new development in back-up rings for years, a 12-page booklet of design, dimensions, and other data on continuous and contoured back - up rings. This new booklet describes the characteristics of back-up rings, and discusses the advantages of contoured and continuous rings. Complete dimensions and operating media data is also included. Parker Seal Co.

Power Tools

A new 68-page power tool catalog contains complete information on over 100 power tools for use in industry, maintenance and other applications. Included are over two hundred illustrations, information on product features and applications and complete specifications. Skil Corp.

Maintenance Booklet 24

A new 16-page picture booklet, presents helpful facts about making maintenance and repair parts. Entitled "One Way to Make Your Job A Little Easier", will be of particular interest to maintenance executives, engineers and other key maintenance personnel. The new booklet offers solutions for those persons faced with the problem of getting machinery repaired and back into production fast . . . and at minimum cost. It will also prove helpful to designers, production and research men who must make any kind of special machinery or equipment requiring machined parts. Included in the booklet are physical properties, chemistry and tolerances for Stressproof Steel Bars, widely used in both production and maintenance and parts applications. LaSalle Steel Co.

Engine Lathes

Bulletin R-206 tells the story of the 21 and 24 in. Regal engine lathes. The bulletin describes the forces of turning every lathe must withstand to maintain its accuracy, and new Regal design features that dissipate these forces. Descriptions and specifications of the Regal plain and sliding bed gap lathes are also included. R. K. LeBlond Machine Tool Co.

Fork Trucks 26

Complete specifications on the world's largest general purpose fork trucks are given in an eightpage bulletin. The two trucks described, the Ranger 600 and 700, have capacities of 60,000 and 70,000 lb at 48 in. load centers and are designed for heavy lifting work. The bulletin gives details on speed, grades and under-clearances; engine and electrical system; power train; brakes, hydraulic systems; dual operator's controls; upright dimensions and general maintenance. General dimensions are shown by drawings on the back cover of the buletin. Clark Equipment Co.

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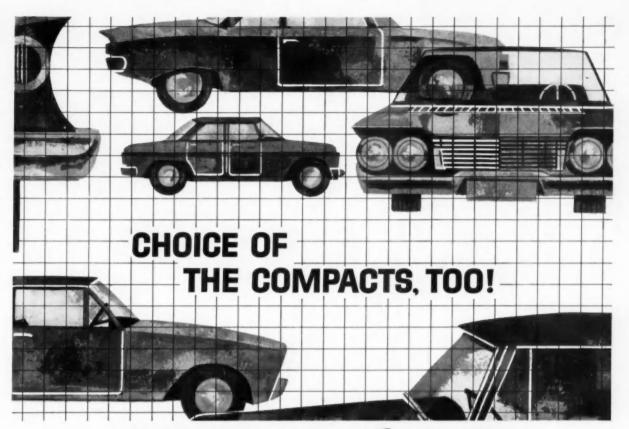
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VALVE SEAT INS

Those new compact engines with WAUSAU Valve Seat Inserts are making history! They are inaugurating a new era in transportation. Again, WAUSAU engineering collaboration with engine designers has been a factor in another great advance by the automobile industry. And again, the quality of WAUSAU products has made a real contribution to automotive progress. Our 40 years of experience and ultra-modern manufacturing facilities are at your service. Phone or write.





VAUSAU MOTOR PARTS COMPANY

2300 Eau Claire St., Schofield, Wisconsin

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Remember when ...

GENE SARAZEN SHOWED THEM HE WAS A "MONEY PLAYER"

The event—the 1929 Agua Caliente Open. At stake—a \$10,000 first prize. And Gene Sarazen trails by 3 strokes going into the final round. As if to increase the pressure, his broker phones to tell Gene he'll be sold out unless he raises \$10,000 within 24 hours. He goes on to win in the final round with a new course record of 65, finishing with a birdie on the 17th hole and a par on the 18th.

Pros have more than a knack. They have the experience and determination to come through under pressure. That holds for the pros of sports or business.

And the pros of the bearing busi-

ness are the craftsmen and engineers of the Timken Company. They have the most experience in designing, applying and servicing tapered roller bearings. They've solved thousands of tough bearing problems. They have the finest research and production facilities behind them. And they've been specializing in one kind of bearing for over 61 years. That's why Timken® bearings can assure the reliable performance that more than meets the higher standards for parts required under today's full year or longer warranties.

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Bearing Pro Elmer Anderson says: "Tough bearing problems? Call on us for the answers that score."

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